GEORGE F. NORDENHOLT, *Editor*

We Must Compete or Decay

DEPRIVE A MAN OF THE OPPORTUNITY to compete, to struggle or to fight for something, he soon ceases to be the fittest. The instincts with which Nature endowed him for his protection and progress become dulled. Physical strength and mental stamina, which can be developed only by exercising them, soften like the rotting wood of a dead tree. Only the fittest survive.

Oliver Goldsmith in his Deserted Village pointed out that, "Ill fares the land to hastening ills a prey, where wealth accumulates and men decay." But likewise, ill fares the land wherein economic and social conditions make it necessary for government to support many of its citizens, who thereby no longer need to compete for a living. The fact that their condition is not of their own choosing but the result of a faulty economic system, will not change the penalty imposed by Nature.

Nature always aims for a proper balance. Both extreme wealth and extreme poverty are discords in Nature's mysterious symphony. When competition ceases, when struggle no longer exists, decay sets in and Nature, through the law of the survival of the fittest, starts setting things right. This applies equally to both individuals and organizations.

When the railroads had a monopoly and ceased competing with one another, railroad officials grew smug, self-satisfied and some of them even arrogant. It was a railroad official who launched the slogan, "The public be damned." But the very dissatisfaction that was caused by this attitude of the railroads furnished the incentives that lead to the rapid development of motor trucking lines, passenger bus routes and the rapid rise of air travel. To be sure, these other modes of transportation were bound to be developed, but the failure of railroads to exert their utmost to give best possible service greatly accelerated the rise of other methods of transportation.

Steel casting and gray iron casting became "dead industries" through lack of lively competition until welded construction and formed rolled steel forced the castings industries to wake up. As evidence of their progress over the last decade, the latest designs of war tanks use cast instead of rolled steel armor.

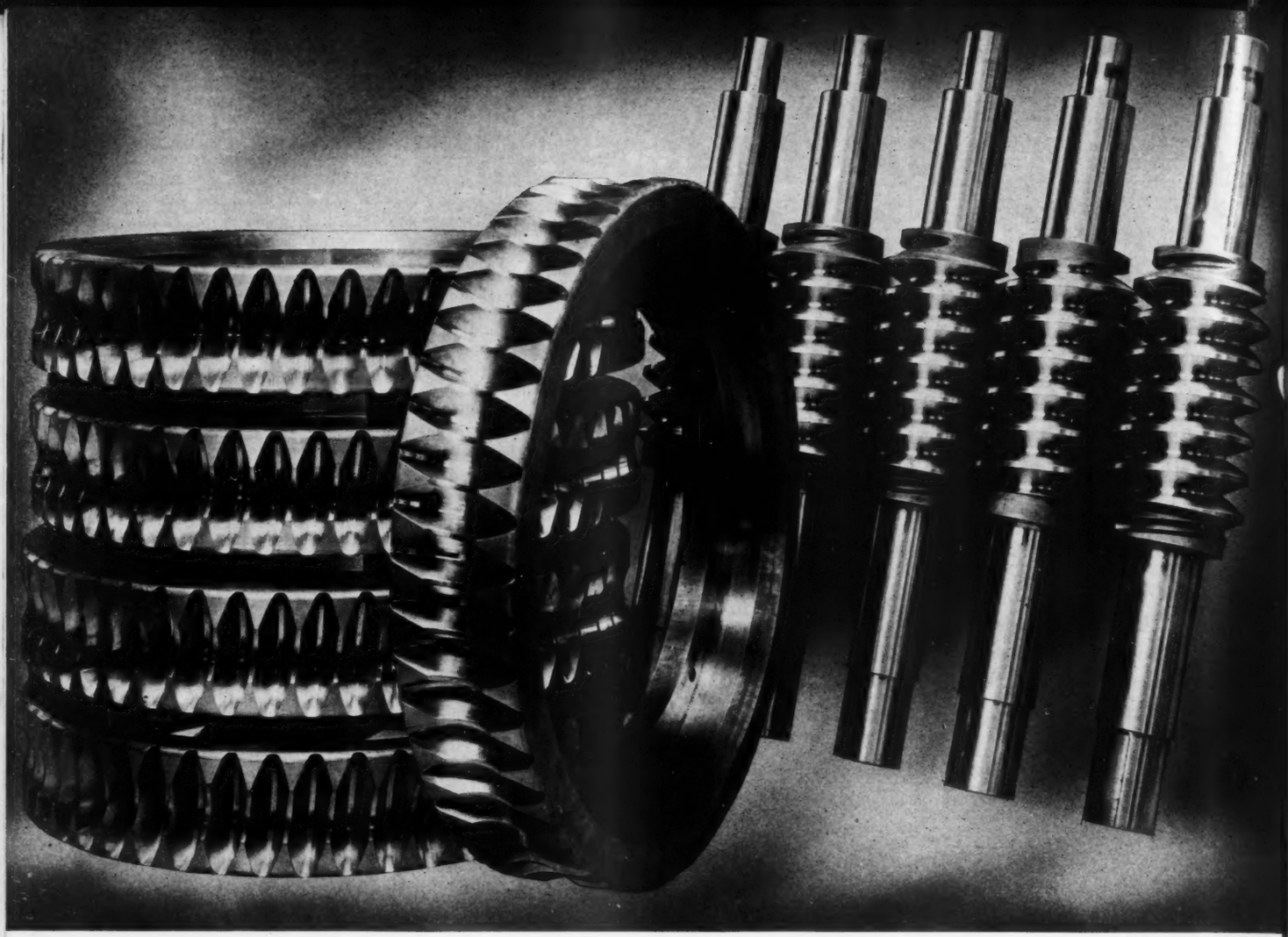
The rapid developments in die castings, steel stampings and molded plastics can be attributed largely to their competitive positions.

One might point to so-called monopolies that are highly progressive, as being exceptions. But the fact is that today there is no real monopoly in the true sense of the word. Aluminum competes with stainless steels, magnesium alloys, and frequently with the other non-ferrous metals. The time is past when any one device, material, or service is indispensable.

With reference to individuals, it is competition that enables the superior engineer to become outstanding. When he has no competition there is nothing by which to measure his qualities. There would then be little incentive for the individual to strive for excellence; there would be no reason for any company to seek the services of an outstanding engineer. This applies to every job, be it laborer or company president.

We are now in the first stages of the greatest production program any country has ever undertaken. The success or failure of that program will determine the future welfare of all of us and all who follow us. The great task is first and last an engineering undertaking—design and production. Our greatest asset toward the successful fulfillment of this program is the high-grade engineering talent developed over the past years by keen competition that impelled and compelled ever higher standards. Our greatest liability in this program is that we do not have enough of such talent and too many of our men lack training and experience for productive work because they have been out of competition too long.

"Competition is the life of business," is an old saying. It is equally true that competition is the very life blood of a nation. Through competitive enterprise we keep fit, and only the fit can survive.



DeLaval Steam Turbine Co.

Bronze wheels of 8 in. face and 11½ in. O.D. alloy steel worm 68 in. long overall, for screwing down rolls on a steel mill

WORMWHEEL DRIVES

Load Factors and Their Influence on Design

WHEN confronted with the problem of selecting a worm and wormwheel for a proposed drive, almost every engineer somehow or other believes that the requirements demanded by his particular application are difficult to meet from the standpoint of performance. Like most other problems, however, when resolved into its component parts the solution is not often difficult.

Any wormwheel set is inherently limited by its design in a number of ways, some of which are the magnitude of torque that it can transmit without breaking down mechanically, in the duration of time that a definite torque can be delivered without over-heating the lubricant, in the working life, and in the amount of deflection that the parts can sustain without destroying the alinement necessary for correct tooth engagement. All of these factors, of course, are given consideration during design. But designs are made to suit specifications, therefore, the importance of preparing accurate data cannot be overstressed.

For many installations load power requirements should be stated in terms of torque rather than horsepower rating. The average load indicates little to the gear designer unless it is accompanied with exact data covering whatever maximum demand torques that may be imposed on the gears in cycles of operation or process. If the designer is informed that peak loads come at regularly recurring intervals he can multiply the average load by a factor to obtain an equivalent steady load to use as the basis for his selection of size. He can also introduce hunting tooth action in order to prevent the heavy load coming on the same set of teeth.

The transmission unit for satisfactory performance must also be designed to suit the rating of the prime mover as

modified by its operating characteristics. If the prime mover is a motor, factors involving the generation of heat, heat dissipation and temperature must be considered separately for the motor and for the gears.

In any worm and wheel design procedure, the operating characteristics of the power input unit, the nature of the load on the driven machine, and the expected life of the reduction unit are the factors that determine the center distance and choice of material for the worm and wheel.

For a given center to center distance and ratio of speed reduction, the choice of tooth dimensions, worm pitch and lead are governed by the proportions necessary to provide wear resistance as dictated by tooth pressure, by rubbing speeds and by the metals used for worm and gear, rather than exclusively by the size of tooth necessary to provide enough strength to resist breaking under static or dynamic load.

Worm gears are designed for high resistance to wear and to shock loads, as well as for static strength based on an ample safety factor. In service for a given horsepower, the dynamic loads on the teeth decrease as the speed increases, hence the factor of safety for strength increases greatly in the high speed ranges. For shock loads, with the force of impact remaining constant, the severity of the shock stress on the teeth and thread at the areas of impact increases greatly as the speed increases; also the margin of safety against impact effects will simultaneously decrease as the speed increases. At low speeds, therefore, shock stresses are not likely to be severe. The effect of impact is largely that of raising stress rather than that of increasing wear. The rebounds or vibrations that accompany shocks are to a great extent cushioned by the lubricant. For a given tooth pressure, therefore, if the tooth proportions are favorable for resisting wear the tooth will generally be sufficiently strong to resist mechanical breaking. At worm speeds of 100 r.p.m., the torque allowable may be 2 to 4 times that which is permissible at 1,700 r.p.m. This condition is an advantage when the torque at starting and at low speeds is large as compared to the running torque.

With increase of speed the load capacity of worm and wheels naturally decreases, as a result of the rise in temperature which decreases the load carrying capacity of the lubricant film.

Resembling journal bearings in some respects, the pressure allowable at the areas of contact is dependent upon rubbing speed which is a function of worm diameter, speed and helix angle. Worms, therefore, are designed with the diameter as small as possible in order to obtain low rubbing speed, as well as to reduce churning the lubricant. For this reason driving shafts with integral worms can be run at much higher speeds than shafts which have the worm keyed on. However, other practical considerations require that the worm be large enough to have sufficient beam strength to resist excessive deflection under load, and to provide a wide tooth contact area.

As in other machine elements wear on the worm thread and the gear teeth occurs chiefly when starting; during this period working surface velocities are not great enough to build up pressure in the film of the lubricant sufficient to separate the metallic surfaces. Of course, when the gears are not inclosed wear is frequently caused by abrasive material fouling the lubricant, and also by corrosion. Wear may also result from excessive loads overstressing the metal at the surface causing it to flake. Even though the worm should run completely immersed in oil, and though the alinement should be mechanically correct, excessive wear may result if the viscosity of the oil is lowered because of insufficient heat dissipation to carry off the heat generated at the areas of tooth contact.

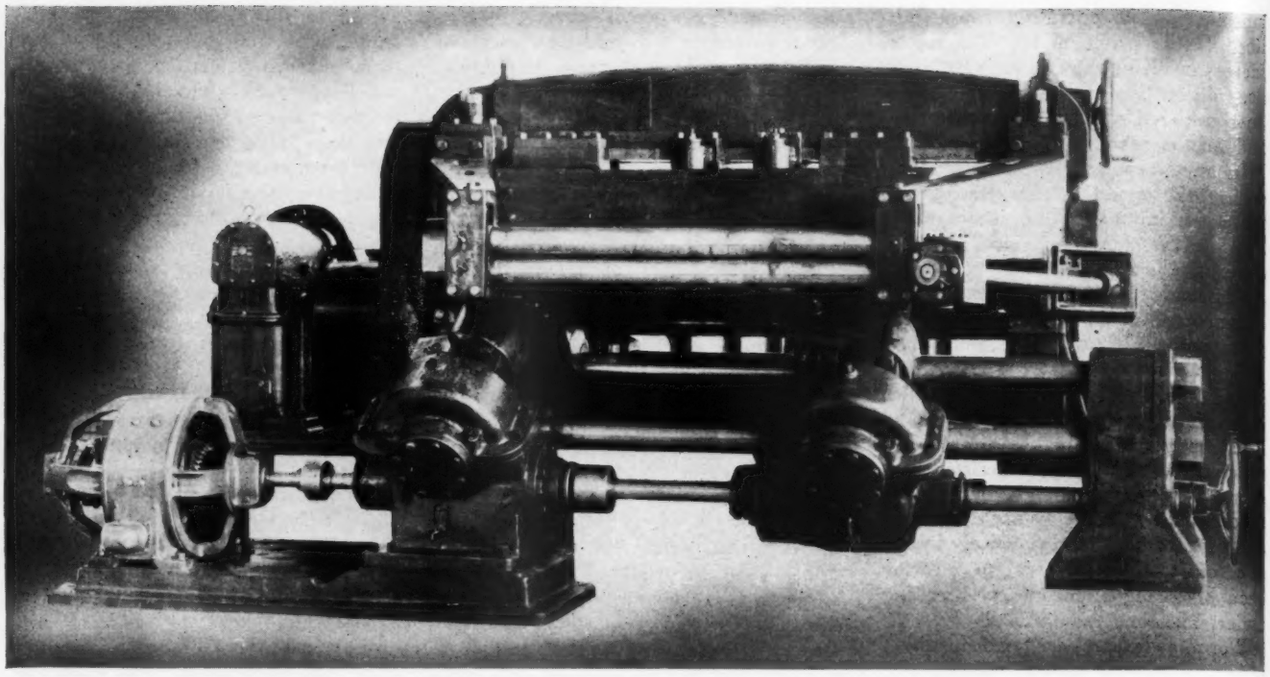
Choice of materials for the worm and wheel are governed by surface endurance properties and low friction characteristics. Other desirable properties are the ability to dissipate heat away from areas of tooth contact, and uniform physical properties with increasing temperature. The high heat conductivity, the low coefficient of friction, and the approximate constant strength over a temperature range of 70 to 400 deg. F. of phosphor bronze, leaded gun metal, and nickel bronze make them desirable materials for wormwheels.

Worms are usually made of S.A.E. 2315 steel and are carefully carburized, hardened and drawn. The surface must be hard to resist wear and offer the lowest coefficient of friction and yet have a strong tough core. There are, however, some unusual applications where this steel is not suitable.

The efficiency is composed of three factors, friction between the worm and gear, friction of bearings, and the hydraulic resistance caused by oil churning. The worm and gear friction follows the law of the coefficient of friction by having its highest value at rest and dropping off with increase of speed, while the oil churning losses increase rapidly with the speed. This increase is the most unpredictable of all the losses as it would probably vary as the third power of the speed except for cavitation. The efficiency question is often over stressed. With ratios up to six to one efficiencies of 97 per cent or better are common with speeds of 300 to 1,800 r.p.m. With high ratios of reduction it is true that there is a de-

DeLaval Steam Turbine Company

Worm and wheel unit, ratio 40, for driving truck wheels on an ore bridge



Heads on trimming shear are operated by two compact worm and wheel units

cided drop in the efficiency but on account of the large torques at low speed the horsepower drops to such a small amount that the gear losses are of little importance.

When heat dissipation capacity is not sufficient to carry off the heat as rapidly as it is produced the temperature of the lubricant and parts become excessive, which in turn decreases the viscosity of the lubricant and results in increased wear. The heat present is only that which is generated by friction of the metal parts slipping on an oil film and that produced by the internal friction in the churning and movement of the fluid itself.

The heat generated in a set is a measure of the horsepower loss or loss in efficiency. The efficiency of transmitting power at the areas of tooth contact depends upon a number of factors, among which are the tangent of the lead angle of the worm, the nature of the contact, the intensity of the load, the speed of rubbing and the coefficient of friction. In a well-designed set, correctly rated for load, properly operated and maintained, there should be no metal-to-metal contact. The overall efficiency of the drive is of course influenced by the power losses of the thrust and radial bearings which support both members of the drive.

With a uniform load and speed the rate of generating heat is constant; and if the radiating capacity of the housing of an inclosed set is sufficient to give off the heat in quantities as rapidly as generated, the oil will attain and hold a constant operating temperature. In order not to destroy the ability of the oil to resist metal-to-metal contact under tooth and bearing pressures, the temperature, of course, should not be higher than would adversely affect the necessary viscosity thus lowering the break down strength of the oil film.

Most inclosed worm and gear sets are now given a thermal capacity rating, usually expressed as the maximum horsepower which can be continuously put into the set without the temperature of its housing rising 50 deg. C. above that of the ambient atmosphere. The thermal capacity is determined by the ability of the exposed case area to give off the heat produced by operation. Although the thermal capacity may be increased by resorting to air or water cooling, great care should be exercised in determining the ability of the prime mover to deliver power input torques which are not greater than the mechanical capacity of the worm and gear to withstand safely.

The practice of driving worm and gear sets with motors of a capacity greater than the rating of the set is prevalent enough to be warned against. When the motor size is excessive the safety feature of the overload release in the starter is lost so far as the gearing is concerned, because if it is set low enough to protect the gearing it will trip out when starting. An overmotored set when excessively loaded at peak periods can easily have a torque input imposed upon it that will break down the oil film at the area of tooth contact, or cause deflections that destroy the alinement necessary for correct tooth engagement. The practice is also undesirable from an electrical standpoint, since induction motors are designed for speeds closely regulated by the frequency of the current and a favorable degree of slip, consequently motors which are not fully loaded rotate at speeds with low slip, thus resulting in poor power factor.

When stopping a set having a motor or turbine drive the flywheel effects on the load side of the set acting at the low end of the speed ratio reduction should fade out in the time it takes for the momentum of the driver to also fade out and bring the set to a standstill, otherwise high reverse torques might be imposed on the set.

In installations where a reversed load torque may be imposed on the wheel shaft when power input is shut off, or when the worm and wheel are at rest, and it is desired to hold the load a brake should be used on the worm drive rather than depend upon a self-locking action between the worm and wheel, but usually a brake having a rating somewhat less than the motor torque should be used, especially when the gear ratio is high. This practice is advisable when one considers how the coefficient of friction varies under static and dynamic conditions. When at rest there is no oil film between areas of contact and the coefficient of friction is a maximum, however, when movement begins the coefficient of friction falls to a much lower value.

There is no fixed angle for reversibility, for even with worms having lead angles of 4½ deg. and less, which are usually considered self-locking under static loads, any vibration at the load end may be sufficient to start motion in a direction reversed to that of the drive. When motion starts even worms with lead angles as small as 2 to 3 deg. may not be self-locking. With motor driven sets solenoid brakes are often used for inching and instant stopping of feed screws and cable drums.

Multiple thread worms, when the number of teeth in the mating wheel is not an integral multiple of the number of threads in the worm, have a hunting tooth effect which can be taken advantage of to prevent regularly recurring peak loads or shocks from always coming on the same set of teeth and the same portion of the worm.

Satisfactory life is a variable period dependent upon requirements of service, such as the desired smoothness of drive, limit of vibration that can be tolerated and reasonable economy of installation and operation. Service life, smoothness of drive and degree of vibration depend upon the wear-resisting qualities of the ball roller and thrust bearings in the set as well as upon the durability of the materials in the worm and wheel.

When a worm and gear are proposed and made especially for a specific installation in which all of the operating requirements and conditions are known, appropriate considerations can be given when designing to factors such as life, static and dynamic loads, wear, heating, lubricant and possible efficiency.

Because of the increased use of worms and gears as step down speed reducers, many gear manufacturers have designed and stock a range of types and sizes of inclosed units. By designing these units for uniform loads to be operated on 8 to 10 hr. periods, and setting up a set of service factor multipliers for various conditions of loading, such as 24 hr. smooth load, intermittent load, 8 hr. recurrent shock load, and 24 hr. shock load, the engineer can select stock sets to meet his requirements.

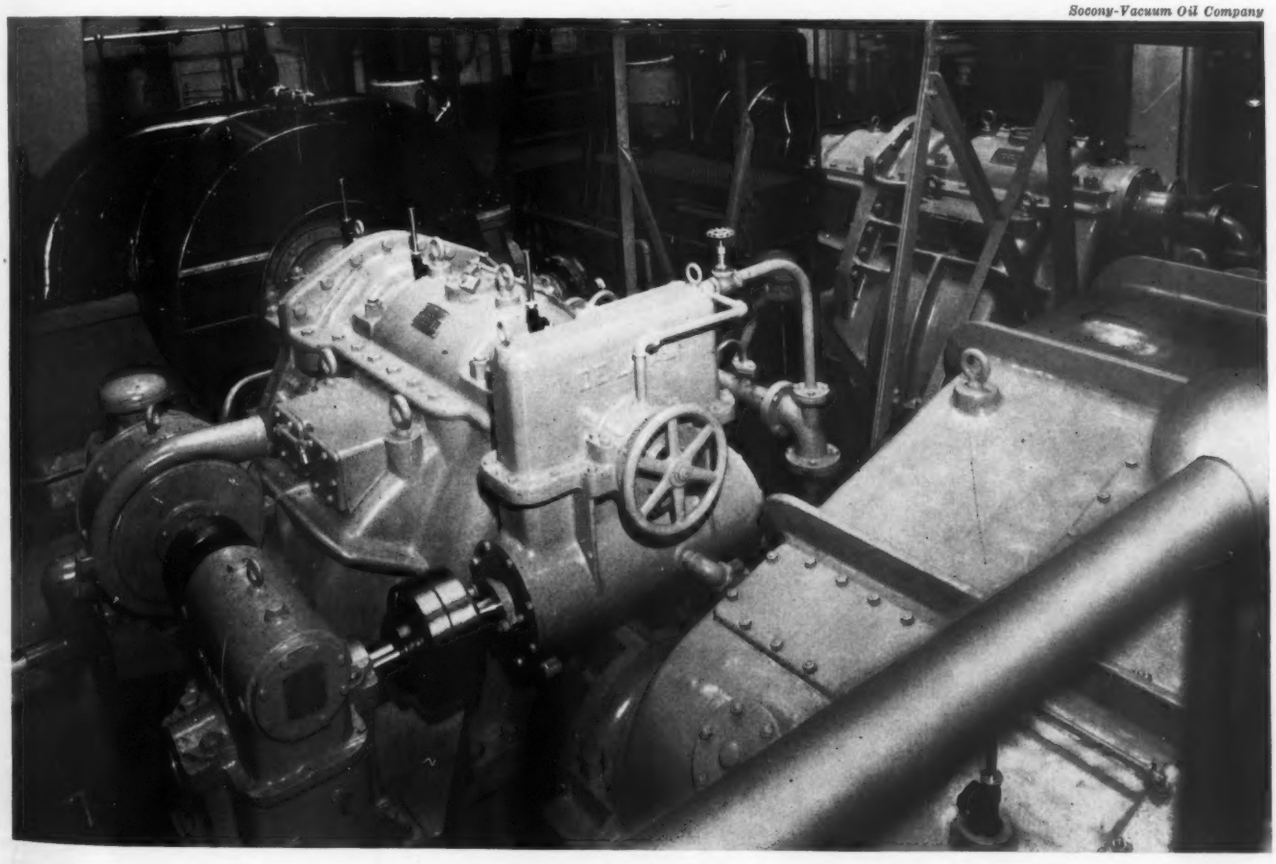
Worm and wheel sets have many inherent advantages as power transmission units. They are quiet and smooth in operation. Because of their compactness they can be installed in small space. Single wheel reduction units are essentially right angle drives, they can be designed with the wheel in a horizontal plane with the worm at either side so that the power take-off shaft may extend either up or down; or they can be designed with the wheel in a vertical plane with the worm either above or below the worm wheel so that the power take-off shaft may extend to the right or left horizontally.

Worms can be selected with a direction of helix angle to suit the direction of rotation of power unit and the driven machine as desired without resorting to idler gears. Reductions in speed can be obtained with single worms and wheels as low as 3 to 1 and as high as 80 to 1. For special purposes much higher speed reductions are of course obtainable.

Ordinarily the best lubricant for worm gearing has been found to be a high grade compounded steam cylinder oil having a viscosity of from 135 to 165 sec. Saybolt at 210 deg. Fahrenheit.

Worm gearing is a specialty and like many other products requires a highly trained personnel of engineers and mechanics as well as expensive equipment for producing and inspecting the parts, therefore it is most economical to take advantage of such experience, skill and equipment by going to a manufacturer of worm gearing for practical advice.

Socony-Vacuum Oil Company

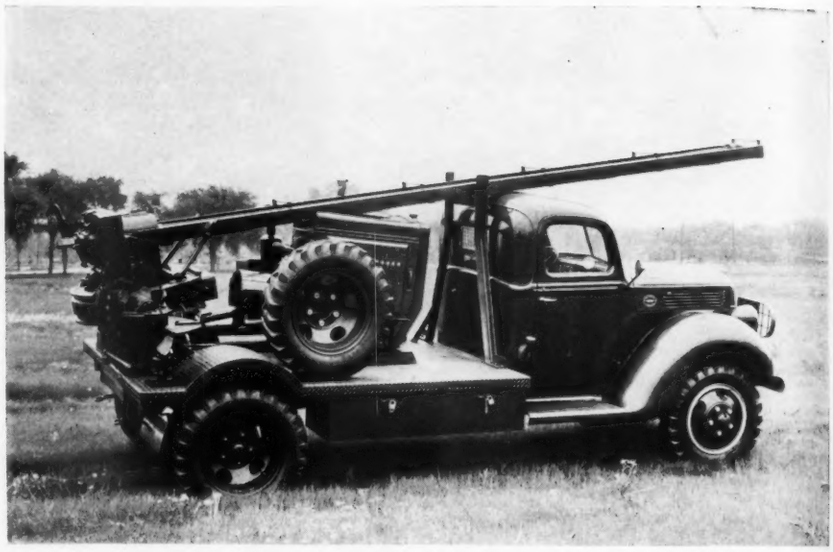


Motor-driven worm gear units for turning-over 4,000 hp. main turbines and propeller shafts of tank steamship. Combined ratio of worm gears and reduction gears is 6,891 revolutions of motor to one revolution of propeller shaft

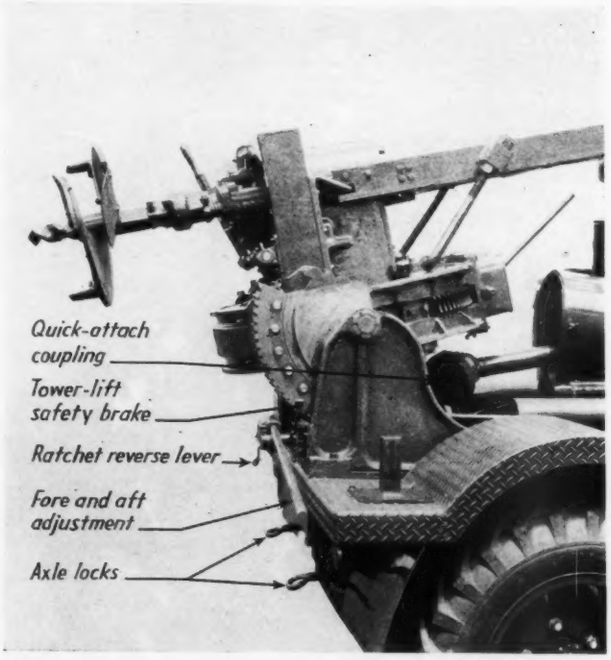
Modern Designs

Earth Drill for U. S. Army

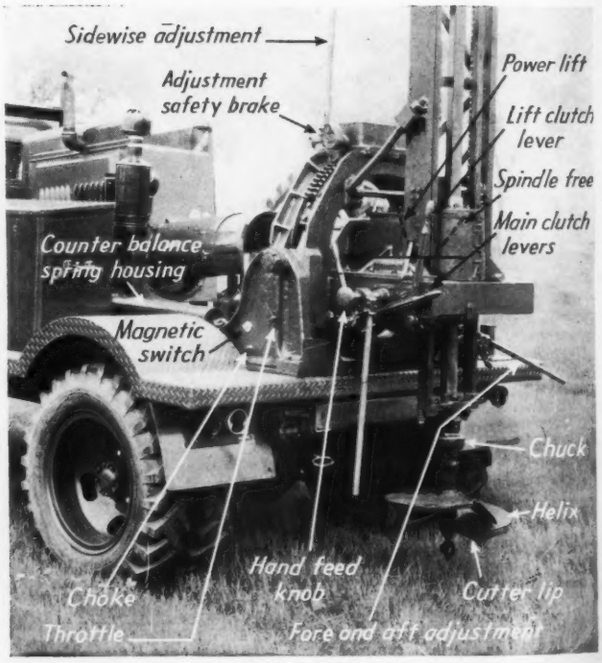
These earth boring machines, built for the United States Army, are to be used for drilling holes underneath roads, bridge foundations, railroads, preparatory to placing of explosives, anti-tank traps or land mines.



Mounted on a special truck, the drill is capable of boring holes from 12 to 24 in. in diameter and up to 15 ft. in depth. The drill spindle is adjustable to drill angular holes up to 15 deg. fore and aft and up to 45 deg. sideways. Power unit is a Buda engine of the four cylinder, water cooled type, with magneto ignition and developing 40 hp. at 2,000 r.p.m. Speed of engine is controlled by a throttle valve. Ratio of engine speed to drill speed is 11.8 to 1.



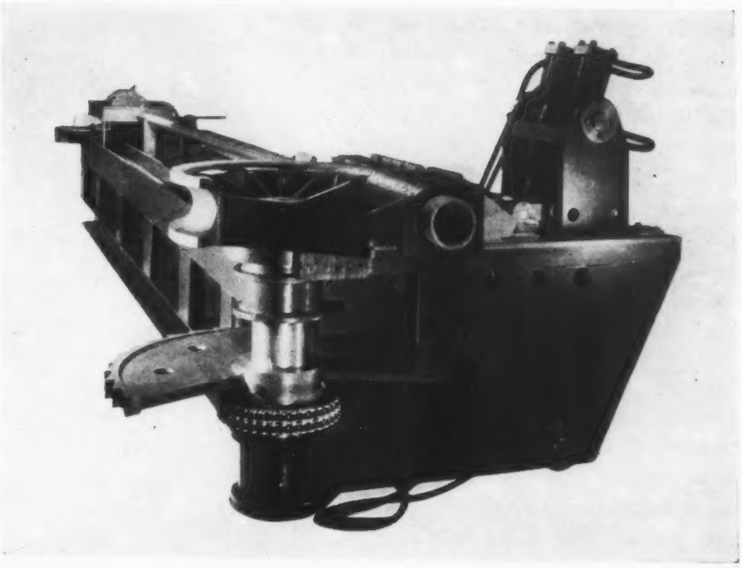
Drill head houses gears, clutches and brake. The drive to the drill head is through a universal joint assembly; one end of which is attached to the stub shaft of the engine and the other to the drill by a special coupling. The head contains both the main driving clutch and the lifting clutch, both of the cone type with removable asbestos lining. All gears are inclosed and run in a bath of oil.



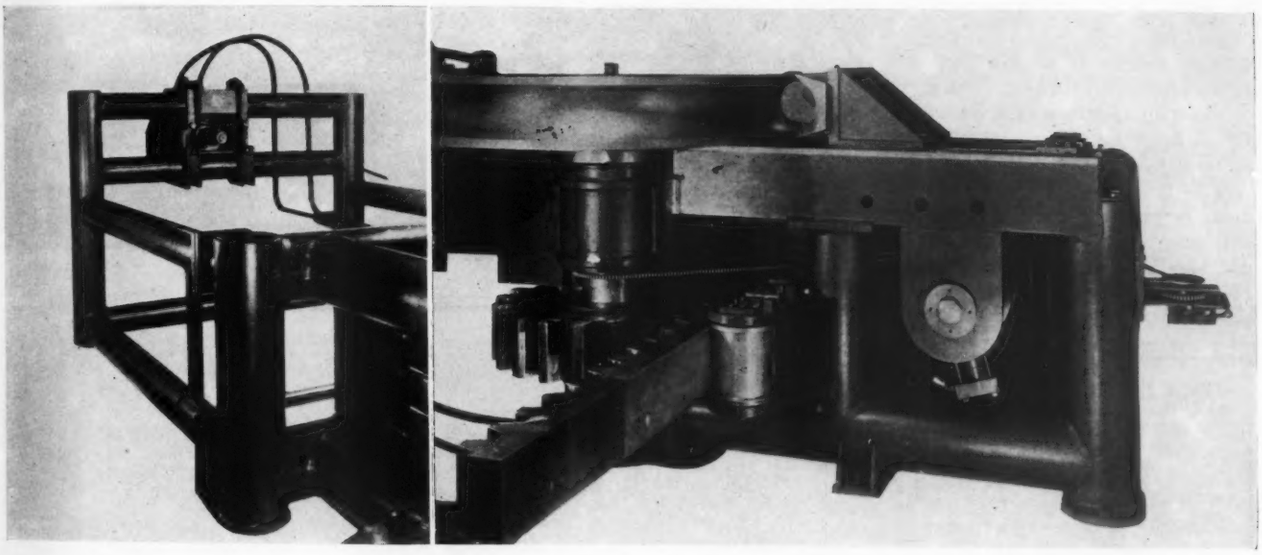
Drill helix is lifted by two chains driven by two sprockets located on each side of the drill spindle. The chains are superimposed on square tubes and are spring loaded to absorb any lifting shock. The lifting clutch brake mechanism is interlocked so that the operator cannot damage the machine. The drill spindle of alloy steel slides up and down on a bronze bushing.

Tubular Construction Replaces Welded Structurals

Increased rigidity was obtained in this new Wallace Supplies pipe-bending machine by replacing arc-welded I-beams, channels and plates with arc-welded pipe construction.



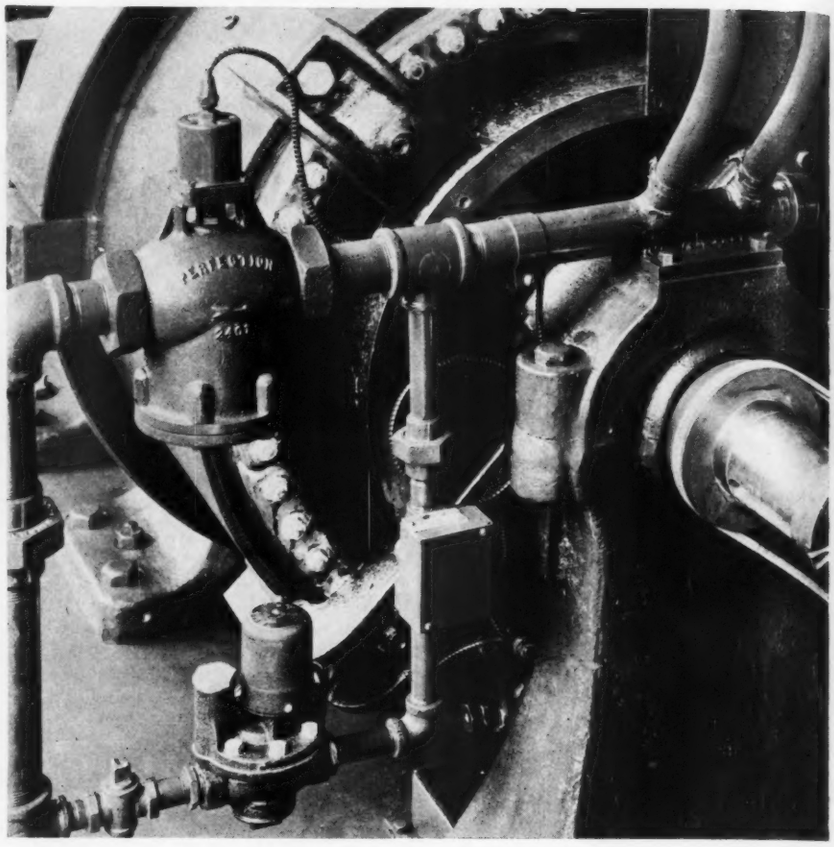
Former design is shown at right. In the new design, shown below, the frame is fabricated of steel pipe varying in size from 6 in. dia., single thickness, to 12 in. dia., double thickness. Torque capacity of the machine was increased from 7,000,000 in.lb. to 13,000,000 in.lb.; frame deflection was decreased from 0.103 in. to 0.013 in. In addition, weight was decreased 10 per cent, welding time reduced 20 per cent and set-up time reduced 25 per cent. The large gear shown is of welded steel construction. Web and plate are S.A.E. 1020. Rim is S.A.E. 3140, flame-preheated to 900-1,000 deg. F. before welding.



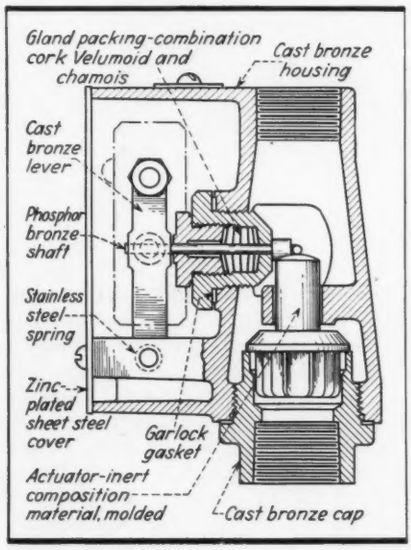
Newest lightweight train, the Southern Belle of the Kansas City Southern lines, is built of aluminum alloy throughout to obtain light weight without sacrifice of strength. Cars are of riveted construction, and are completely insulated with Fiberglas held in place with aluminum bands. Power is provided by 2,000 hp. diesel-electric locomotives built by the Electromotive Corporation. The 12-cylinder diesel engines are direct connected to a d.c. generator which supplies current to four traction motors geared directly to four driving axles. The front end is trimmed red and yellow contrasting with dark green. The red and yellow are carried back in sweeping curves.

MODERN DESIGNS – Flow Interlock Valve

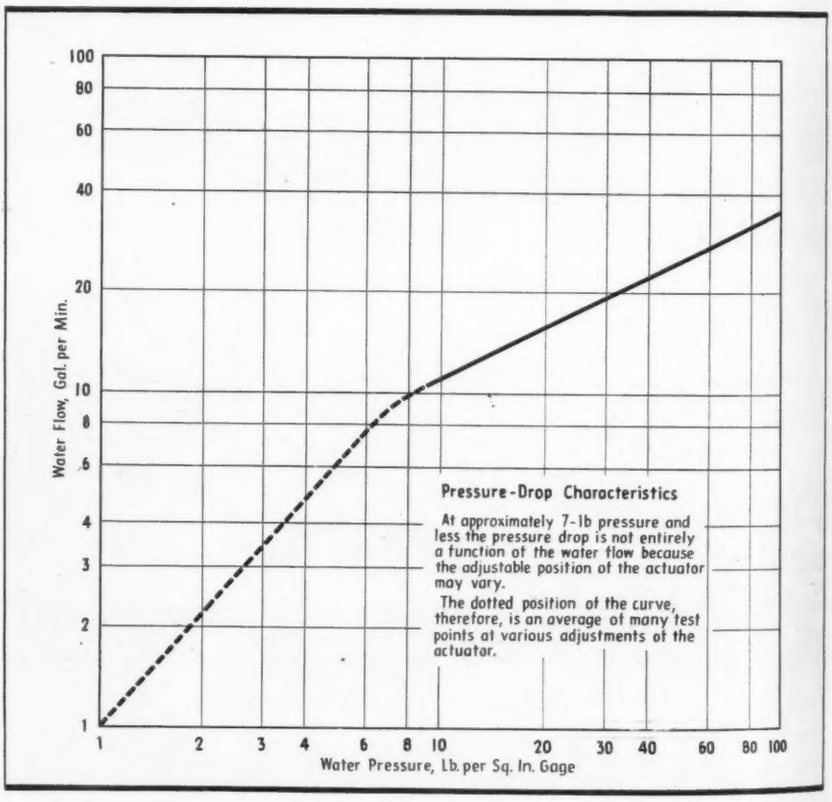
In the operation of the General Electric Disposall, a medium flow of cold water is required to facilitate the grinding and pulping action. In use it has been found that the person operating the device might neglect to turn on the cold water, might turn on too much or too little, or might use hot water. To obviate this difficulty a special flow interlock valve was developed. Motor cannot start until the proper amount of cold water is flowing. This design of interlock valve is also being used in air conditioning systems and in the inductor dynameter of 600 hp. shown at the right.



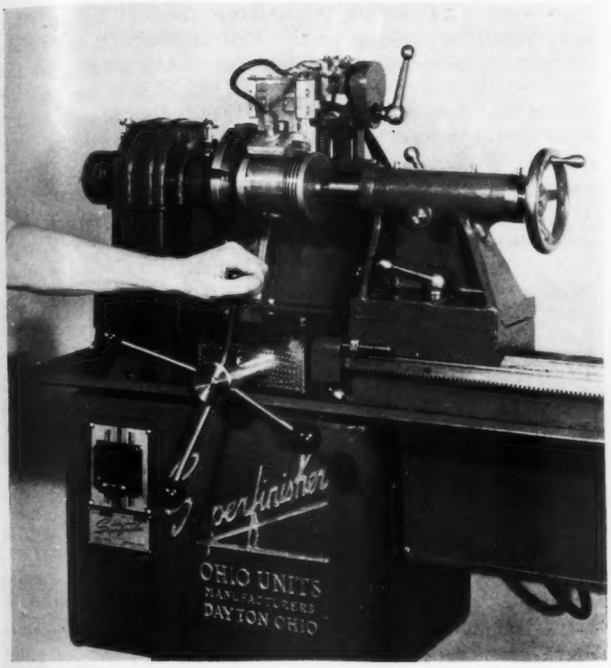
Flow interlock device responds to a flow of fluid independently of pressure to close an electrical contact when the flow is in excess of a preset amount and to open the contact when the flow decreases below a preset amount. Adjustment is provided so that the contacts will open on any water flow from ½ gal. to a maximum of 14 gal. per min. Flow characteristics of the valve are shown on the curve at the right.



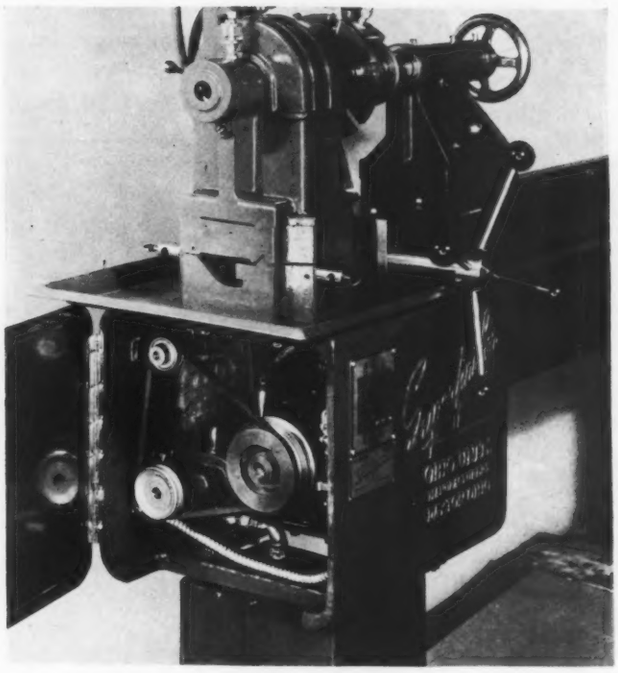
Cast bronze is used for the housing. The actuator is of inert molded composition material. As designed, the flow interlock does not control the amount of flow. Flow differential between the cut-in and the cut-out of the electrical contact is approximately 15 per cent.



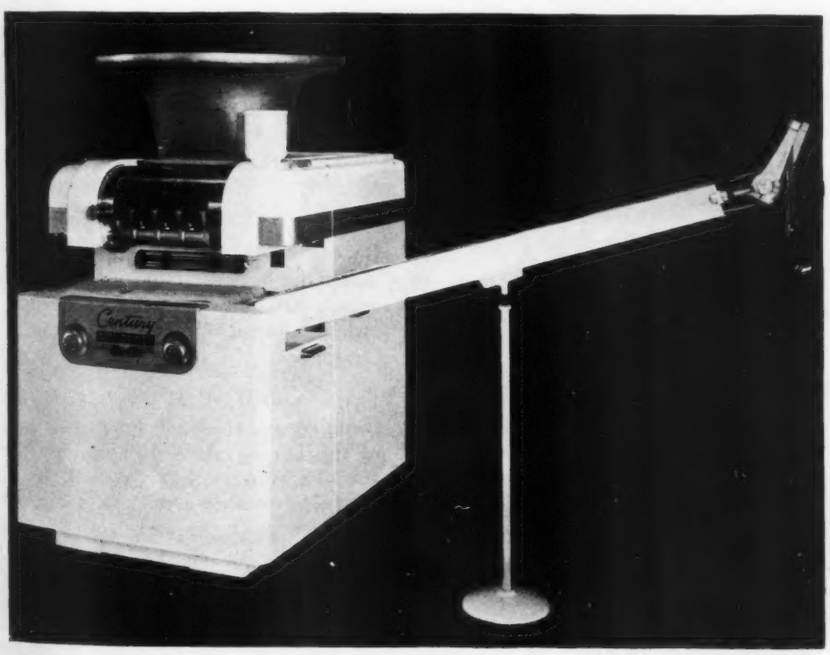
Flexible Cable Drive in Small Superfinisher



Oscillating head of the Superfinisher designed by Ohio Units is driven by means of a flexible cable, to reduce weight of oscillating and traversing mechanism to the minimum. A ⅓ hp. back-geared motor operates the machine by means of two V-belts, one driving the headstock and the other the flexible shaft and the lubricant pump.



Two speeds are available for the spindle. Provision is made for reversible stone holders, thus at a single set-up both roughing and finishing stones can be used. The pressure of the stones against the work is controlled through a spring-adjusting device. A gear-type pump with a capacity of 1½ gal. per min. is mounted in the base of the machine.



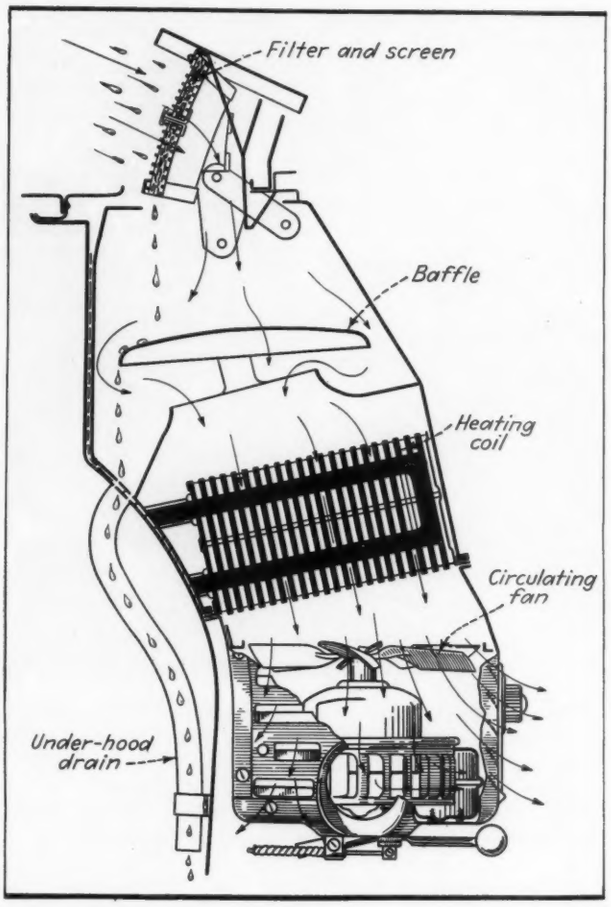
Four-pocket dough divider designed by the Century Machine Company and styled by Harold Van Doren & Associates, has a completely smooth white enamel casing with screw head and hold-down bolts concealed. Agitator mechanism and Alemite fittings are readily accessible for servicing.

RANDOM JOTTINGS ABOUT NEW PRODUCT DEVELOPMENTS

An interesting three-dimensional effect has been obtained in the plastic bezel on the 1941 Silvertone radios. An unusual depth of color is furnished by molding of transparent material and spraying color on the rear surface only. An additional advantage is that the plastic supplies a protective coating for the colored surface.

Molded by the Plastics Division of Erie Resistor Corporation, this Tenite II plastic part is colored to harmonize with the radio cabinet in which it is installed.

The name "Hudson" on some 1941 models is in chrome plated die-cast letters fastened to the hood with speednuts; on other 1941 models the letters are Tenite II also fastened with Speednuts.

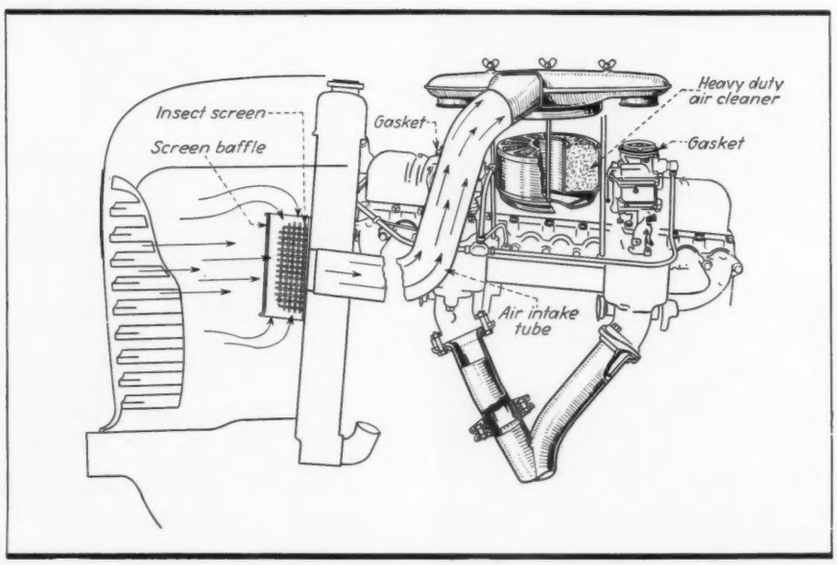


Air duct and water separator attached beneath the cowl ventilator opening on the 1941 Hudson. Incoming air passes over a series of metal baffles, so arranged that the cowl ventilator can be kept open during rainstorms and air drawn in while water is diverted and discharged in the rear of the motor compartment. An inlet screen is built into the ventilators. A cactus fibre filter can be installed if desired. This design supplies a constant supply of fresh air regardless of outside weather and prevents fogging of windows in a tightly closed car. Drafts are eliminated because air coming in through the cowl ventilator builds up pressure inside the car so that inside air is forced out.

FLEXIBLE HOSE placed in the fuel line dampens sound from the fuel pump and prevents sounds from being telegraphed to the frame and body through the gasoline pipe in 1941 Buick. Hose is of Neoprene, wound with piano wire and canvas-covered.

AN INTERESTING FEATURE of the new Hudson is that an entirely new "torpedo" effect has been obtained by a minimum of body die changes. The entire roof line was altered to lower the crown, involving changes in the roof die which extends from below the rear window to about one-half of the windshield pillars and header. Door dies were changed for reveal moldings and concealed hinges. Front end dies were kept substantially the same.

A SPONGE RUBBER SEAL is used under the hood of the 1941 Chevrolet to prevent air leakage over the top of the radiator. Elimination of this air "short-circuit" has been found to improve cooling conditions considerably.



Air intake and cleaner for the 1941 Buick compound carburetion set-up supplies cool fresh air to the carburetors rather than warmed or heated air under the hood. Air, drawn through a screen from behind the radiator grille, is carried through a large fabric tube reinforced with wire to a new heavy-duty oil bath air cleaner attached to an air intake manifold, which in turn connects to the air intake of both carburetors. In this way both carburetors receive a supply of fresh cool air at all times.

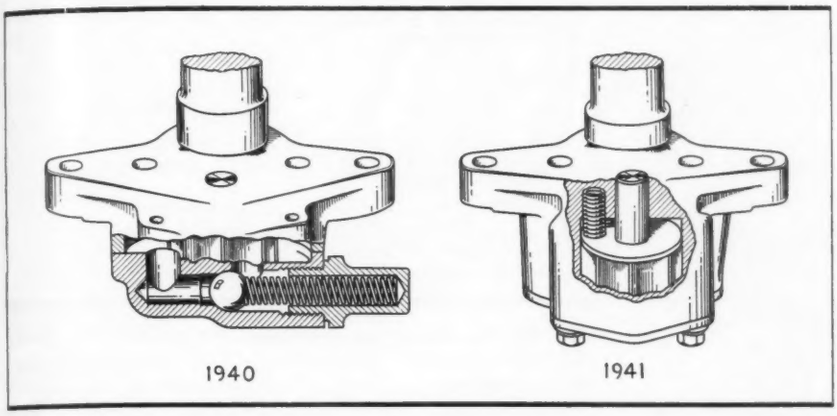
FRONT SHOCK ABSORBERS on 1941 Ford have 20 percent more fluid capacity. Both front and rear shock absorbers have a new type metering adjustment with a double tapered valve which increases the range of adjustment for the same degree of valve action.

GASOLINE TANK FILLER cap is concealed under the left rear lamp on new Cadillacs. Assembly is hinged to fender, swings upward to expose filler cap.

RIDE STABILIZER on 1941 Ford has swinging shackle connections at the ends of the bar in place of bushings. The shackles swing through a small arc as the axle moves up and down. The slight reduction in the length of the stabilizer bar arms has the effect of increasing the torsional resistance of the bar so that stabilizing action is increased. Connections do not require lubrication. Fore and aft motion of the front axle about the radius rod pivot point has been decreased since the distance from the axle to this point is 4 in. greater than in the 1940 models.

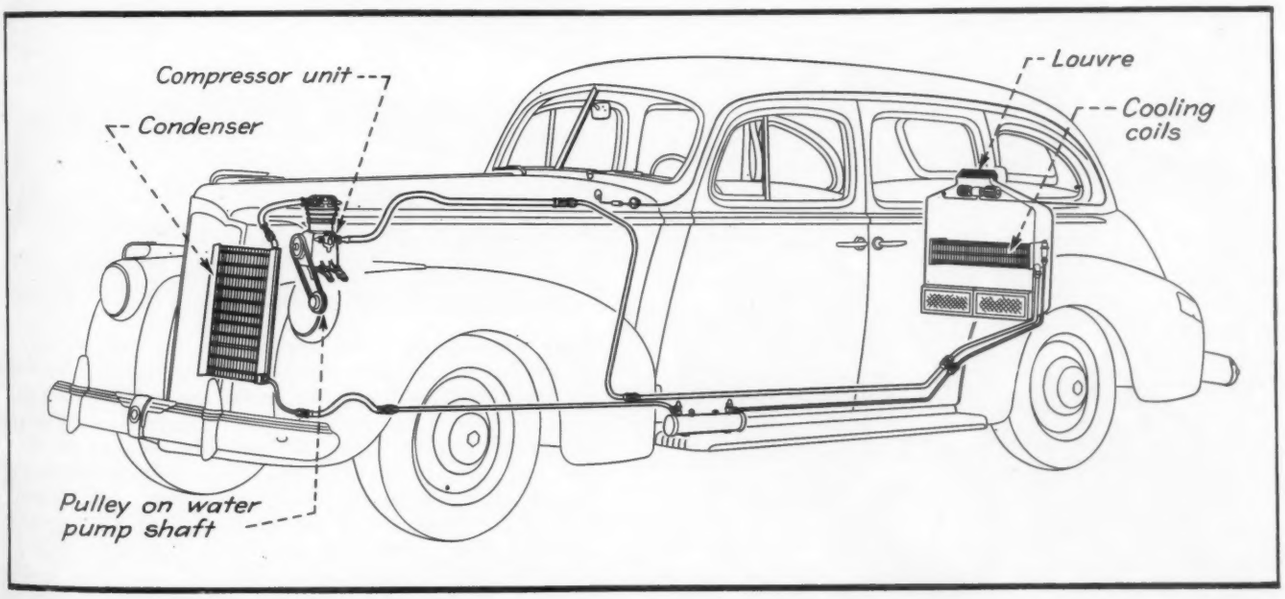
MODERN DESIGNS – Engineering Features of 1941 Cars

These two pages represent the final installment of design details in the 1941 automobiles. Twenty-four pages of this material appeared in October, two additional pages in November.

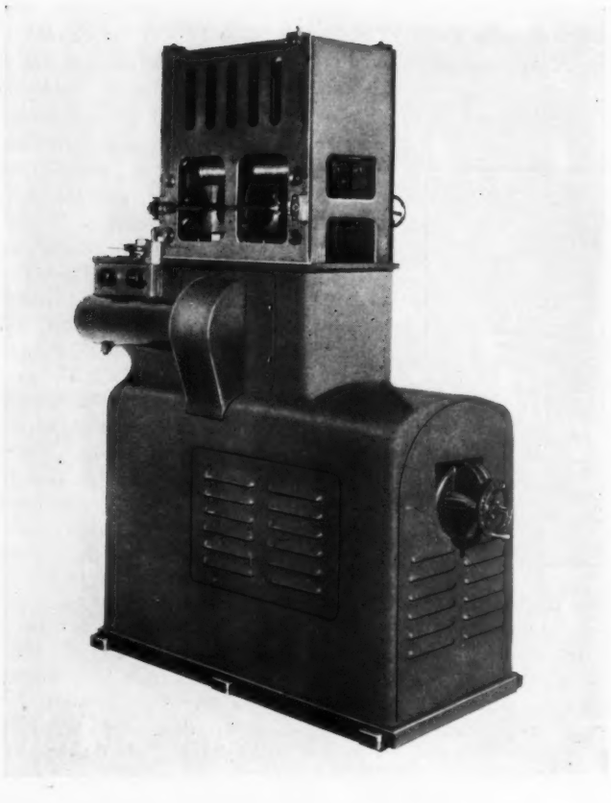


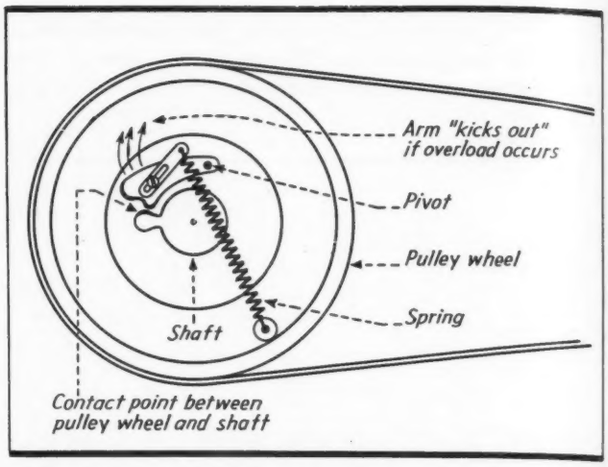
New oil pump in the 1941 Pontiac. Pressure control is incorporated in the pump body. Control comprises a ¼ in. clearance chamber above the oil pump driven gear, closed by a steel disk resting directly on the gear. Pressure between the gear and disk is maintained with two small coil springs. When pump pressure exceeds normal, the disk is lifted against spring pressure to permit oil from the pressure side to seep back across the top of the driven gear to the suction chamber. This method controls oil pressure within close limits and replaces former types in which the controlling mechanism consisted of a preloaded ball valve housed in a drilled passage in the oil pump cover.

INSULATION. The Packard steel roof is insulated by a sound-deadening material permanently cemented to the underside of the steel. The pressure of a spring steel roof bow prevents any drumming in the roof. Rear-quarter panels are insulated with the same material as is used under the roof. The panels over the wheel housings have a sprayed-on coat of plastic insulating compound. The insides of the doors are sprayed with a viscous asphaltic compound; top and sides of the cowl are lined with jute. The trunk is insulated with a thick layer of asphalt-impregnated felt cemented to the lid. The side walls and top of the trunk are also coated with a sprayed-on layer of special compound. The interior of the trunk is then sprayed with a liquid foundation binder. While it is still wet and sticky a dry, fibrous finishing material called "flock" is sprayed under air pressure over the whole interior surface. Flock is a combination rayon-cotton material with fibers about $\frac{1}{8}$ of an inch long. These fibers have the peculiar property of standing upright when they come in contact with the special liquid cement, thus the finish given to the interior of the trunk closely resembles suede.



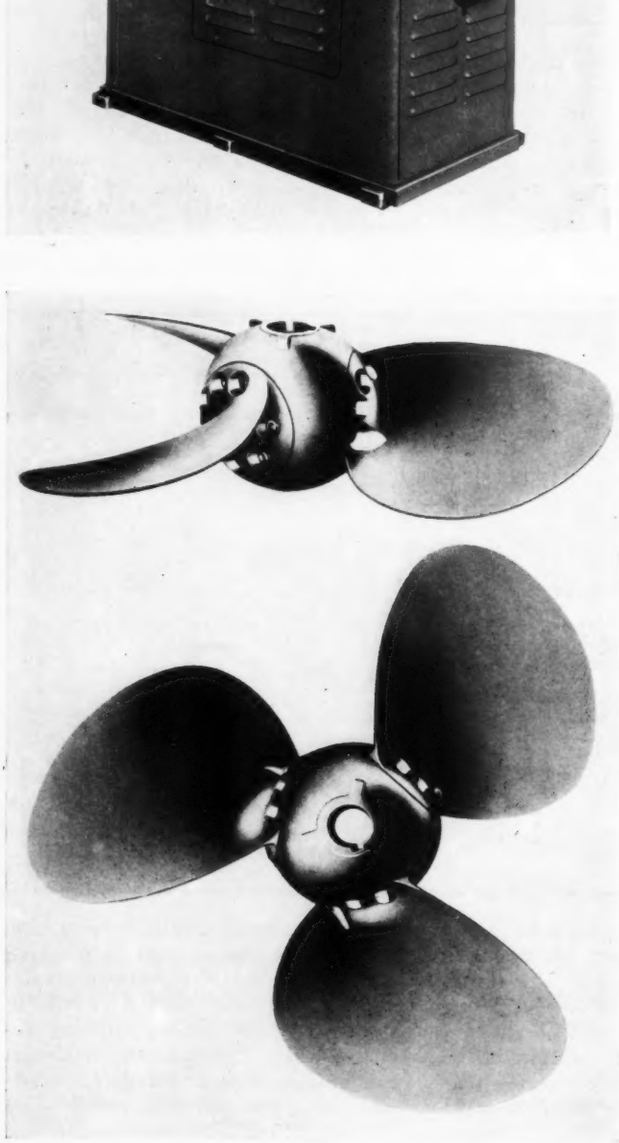
Air conditioning in the 41 Packard. The compressor unit, mounted on the engine block, is driven by V-belt from a special pulley on the water pump shaft. Condenser is mounted in front of the radiator core. When the engine is started, refrigerant is drawn into the compressor pump and compressed to pressure of 180 lb. per sq.in. The condenser unit is located directly in the current of cooling air drawn in by the engine fan. Cooled air is drawn into the car interior by an electrically driven, sirocco-type blower located behind the rear seat. The capacity of the conditioning unit is rated as 1½ tons of melting ice in 24 hr. at a car speed of 60 mi. per hr. With air conditioning installed, special insulation consisting of aluminum foil is used in the roof, sides and floors. Compressor operates at 70 percent of crankshaft speed. To insure adequate cooling in the condenser and at the same time maintain full cooling efficiency in the car radiator, large-diameter fans are used in both the 110 and 120 series.

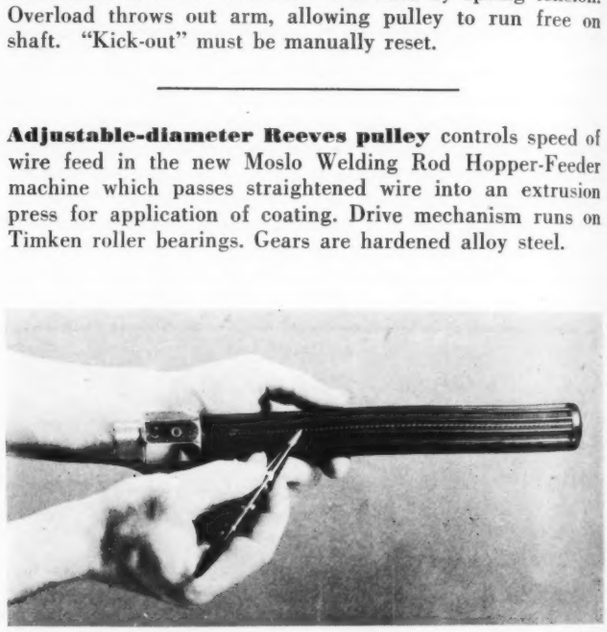




Overload release mechanism on the Yorkaire bituminous stoker has the "kick-out" arm held by spring tension. Overload throws out arm, allowing pulley to run free on shaft. "Kick-out" must be manually reset.

Adjustable-diameter Reeves pulley controls speed of wire feed in the new Moslo Welding Rod Hopper-Feeder machine which passes straightened wire into an extrusion press for application of coating. Drive mechanism runs on Timken roller bearings. Gears are hardened alloy steel.





Static electricity is discharged in the new Goodrich gasoline hose by utilizing the conductivity of the synthetic rubber and brass wires spaced equally around the nozzle. The brass wires are placed in four of the 16 semi-circular stiffening ribs molded into the surface, with the outer edge of the wire flush with the surface of the ribs. These wires extend under and contact the metal coupling of the nozzle. Other advantages of the design are faster flow, better air venting, and protection of the automobile surface.

Adjustable-pitch blades are detachable in a new impeller installation made by the Federal-Mogul Corporation. The installation consists of three 3-blade impellers cast of Ni-Resist, each 45 in. in diameter and weighing 355 lb. assembled. Blades are mounted on Monel studs with Elastic stop nuts and can be adjusted to any pitch between 34 and 40 in. This construction permits convenient installation of the impellers as four small units—hub and three blades.

STEEL TUBE FUSELAGES – III

Major Fittings and Joints

JAMES E. THOMPSON and T. A. LOWE
Vultee Aircraft, Inc.

IN THE SECOND OF THIS SERIES of articles on steel tube fuselage design, published in the November number of PRODUCT ENGINEERING, major fittings and joints for engine mountings and fuselage sections were discussed and illustrated with practical proved designs. An overturn structure for open cockpit planes was also illustrated.

In this third installment, attachment methods for composite type fuselages, welded telescope joints and empennage and tail attachment fittings are covered. The location of these fittings is shown in Fig. 11, p. 513, November number.

Semi-Monocoque Section Attachment Fittings

In a composite-type fuselage, wherein a steel-tube forward section is joined to an aluminum-alloy semi-monocoque aft section, the attachment method used is similar to that for the engine mount. A forged fitting, practically identical with that used at the longeron forward ends for engine mount attachment, is welded to the aft termination of the longeron, connected with a single through-bolt to a stirrup fitting riveted and bolted to the semi-monocoque forward bulkhead ring and longitudinal members.

The method of joining two-section all-steel-tube fuselages, wherein the aft section is removable from the forward section, is practically identical with the attachment method of engine mount to fuselage and in many cases it is practical to use the identical forgings to form the connecting fittings.

When permanent connection between forward and aft sections of an all-steel-tube fuselage is desired, a telescopic type of joint similar to that shown in Fig. 20 is probably the least expensive, and is definitely preferable to the so-called "fish-mouth" joint. The latter requires two angular cuts, and excessive handling of the welding torch around corners.

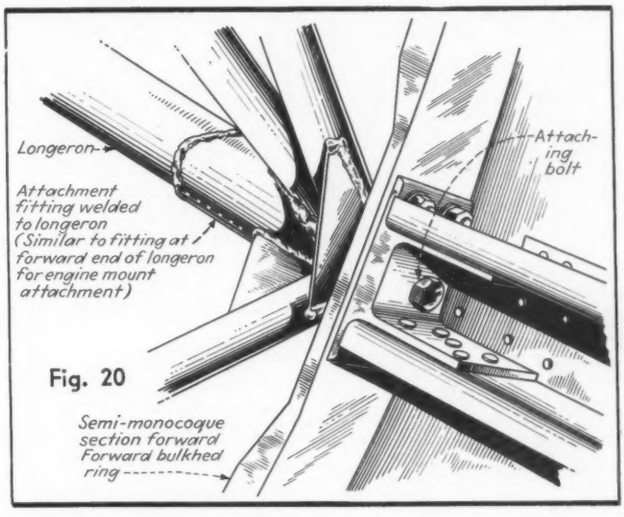

Longeron
Attachment fitting welded to longeron (Similar to fitting at forward end of longeron for engine mount attachment)
Attaching bolt
Semi-monocoque section forward
Forward bulkhead ring

Fig. 20

Welded Telescope Type Joints

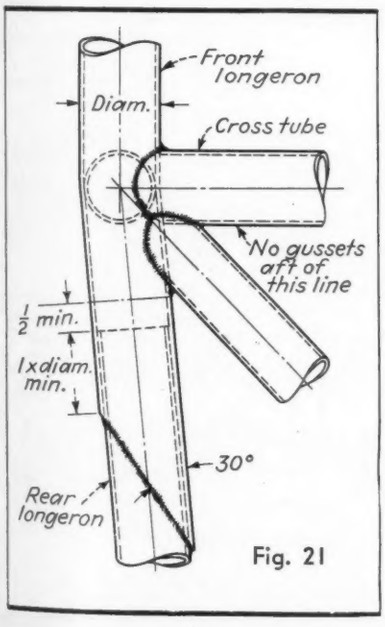


Fig. 21

For permanent connection of two tubes, the telescope-type joint shown in Fig. 21, is generally used where it is desired to effect weight saving by reducing the longeron diameter in the aft section of the fuselage and to break the structure down into sub-assemblies in order to facilitate production. This is accomplished by selecting a tube O.D. for the aft section longerons that will form a free slip-fit inside of the stub ends of the forward section longerons. When these joints are designed it is important to allow a minimum of ½ in. from end of inner telescoping tube to the nearest weld, because the outer tube is certain to be warped out of round immediately adjacent to the junction with vertical and cross tubes.

Intelligent selection of tube inside and outside diameters will permit designing telescope joints that will have a slip-fit between tubes without the necessity of reaming the outer tube. For example, use an 1⅛ O.D. × 0.058 or 0.049 wall outer tube in combination with a 1-in. O.D. inner tube for a telescope joint.

Where it is desired to place a bend at the stub ends of the forward section longerons in order to secure alignment with the aft longerons, it is preferable to make these bends cold, so long as the amount of bend required does not exceed 15 deg.

Gussets should not be used between the stub ends of the forward longerons and the connecting vertical and cross tubes. This is to allow sufficient flexibility at assembly of the forward and aft fuselage sections. Both of these sections are completely welded by the time the final connecting joints are welded and the stub ends should be left perfectly free, in order to provide maximum flexibility for final alignment of the forward and aft fuselage sections at assembly. (*Continued on next page*)

Empennage and Tail Gear Attachment Fittings

Typical layout of attachment fittings for empennage and tail gear connection to an all-steel-tube structure. Auxiliary views of the attachment fittings give complete details of the construction of each. It should be remembered, in connection with these fittings, that a vast variety of horizontal and vertical stabilizer forms are possible. Those shown are based upon a practical, production airplane design and simply represent one completely feasible way of making these connections.

The next installment of this article will consider the various detail fittings required for the normal complement of major installations, such as control systems, as well as those for equipment and furnishings items, such as radio equipment and pilot seats. The article will appear in an early number.

Fig. 22a

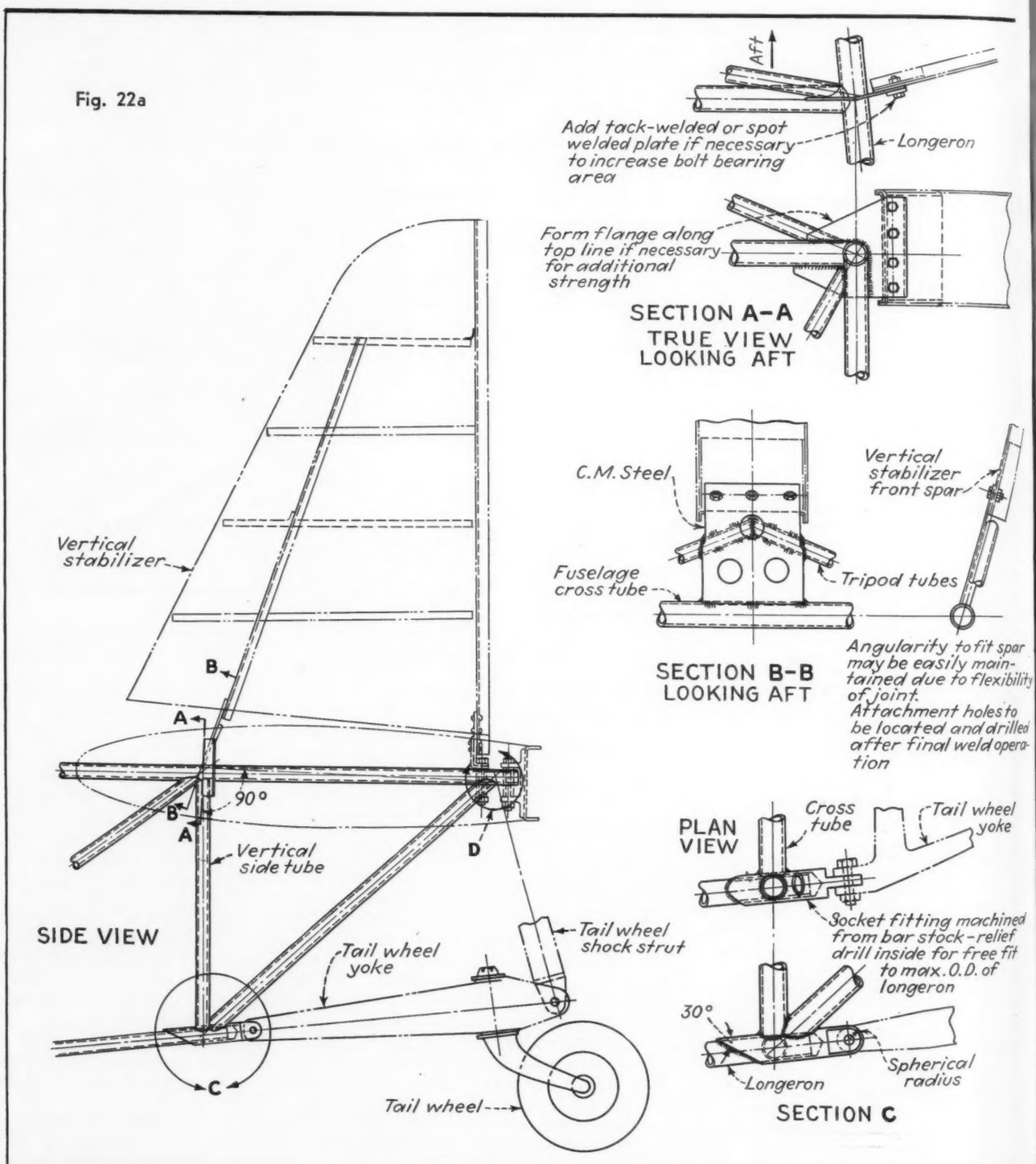
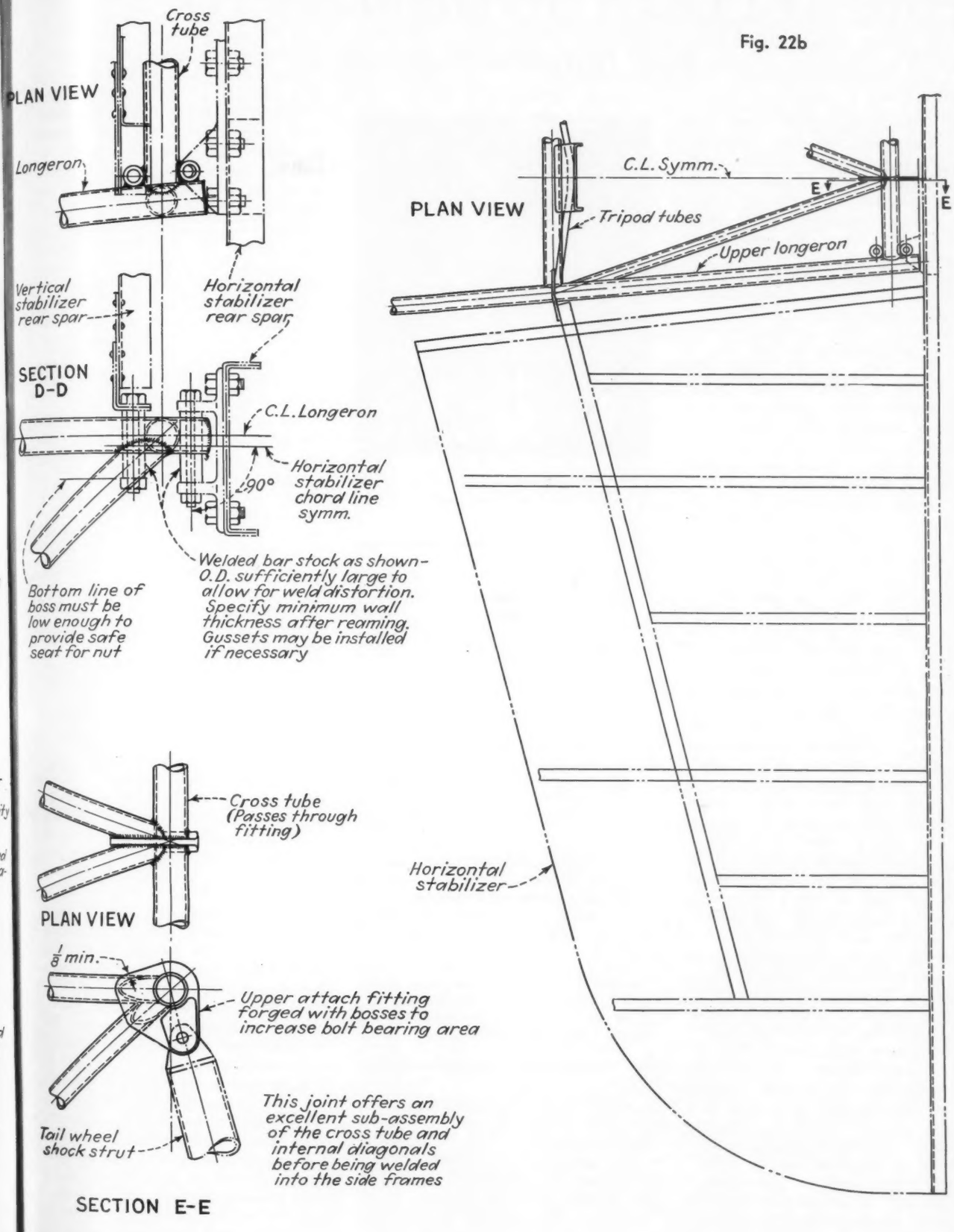


Fig. 22b


Cross tube
PLAN VIEW
Longeron
Vertical stabilizer rear spar
Horizontal stabilizer rear spar
SECTION D-D
C.L. Longeron
90°
Horizontal stabilizer chord line symm.
Welded bar stock as shown-O.D. sufficiently large to allow for weld distortion. Specify minimum wall thickness after reaming. Gussets may be installed if necessary
Bottom line of boss must be low enough to provide safe seat for nut
C.L. Symm.
E
E
PLAN VIEW
Tripod tubes
Upper longeron
Horizontal stabilizer
Cross tube (Passes through fitting)
PLAN VIEW
1/8 min.
Upper attach fitting forged with bosses to increase bolt bearing area
This joint offers an excellent sub-assembly of the cross tube and internal diagonals before being welded into the side frames
Tail wheel shock strut
SECTION E-E

NYLON FILAMENTS

For Industrial Brushes

UNTIL recently, most industrial brushes have been made with hog bristles. But war conditions have made it difficult to obtain them from India, Russia and China, the principal sources of supply. Also, hog bristles have serious shortcomings in applications where the brush operates in constant contact with water or corrosive liquids, and in applications where abrasion is severe. Hence the growing importance of nylon monofilaments in industrial brushes, for in these two fields of applications nylon is superior to natural brush materials such as hog bristles, tampico fibers from Mexican cacti, palmetto fibers from Florida palm trees, bassine, split rattan, reed fibers, horse hair, hickory splits, rubber and bamboo.

Principal considerations in the design of a brush are the selection of a type and size of bristling material that will stand up under the existing conditions of temperature, abrasion, and contacts with liquids or corrosive reagents; the required stiffness of the brush; selection of suitable core or backing material; determination of methods for inserting the bristles; and design and mounting of the brush core. The table listing the general physical and chemical properties of nylon monofilaments, can serve as a guide when considering nylon for a given brush.

Since the limiting factor in the life of a brush used wet is its loss of stiffness through moisture absorption, the fact that nylon absorbs only one-fifth as much moisture as does natural bristle indicates that brushes used wet are in its biggest field of industrial application. For example, in high-capacity machines for washing beverage bottles the brush bristles are in constant contact with hot caustic solutions and are repeatedly flexed as they pass through the bottle necks. After washing 55,000 to 85,000 bottles a hog bristle becomes so soggy and limp that it loses its effective scrubbing action. It is claimed that nylon filaments in bottle washing brushes such as that shown in Fig. 1 have from three to eight times the life of rubber and hog bristles.

While nylon is soluble in cresol, phenol, formic acid and concentrated mineral acids, it has unusual chemical resistance to most of the reagents common in industrial use. Although the filaments will soften slightly when immersed in water at or near boiling temperature, the material has a high melting point of 507 deg. F. and can be steam sterilized.

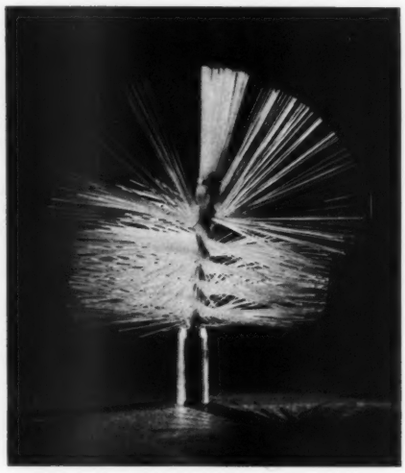


Fig. 1—Most typical application of nylon is in this bottle washing brush

IN 1930, after two years of research to synthesize a useful fiber by polymerization, a Du Pont chemist thrust a glass rod into the contents of a specially designed still and withdrew a fine, sticky thread which hardened on cooling. Peculiarly, the thread could be permanently stretched up to a point where it reached a state of true elasticity. In this stretching process, chaotic chains of molecules were reoriented to form long orderly chains parallel to the axis of the fiber, as in natural silk.

Thus was nylon born. After seven more years of research Du Pont selected one of their new group of synthetic fibers for commercial production, and applied the generic name nylon to all synthetic fiber-forming polymeric amides derived from coal, air and water. First experiments with nylon for brush bristles began in 1938, and the following year saw its introduction in tooth brushes and industrial brushes.

The smoothness of the synthetic fiber, in contrast to the surface of natural bristle which is composed of many minute sharp scales, will not permit rapid penetration of dyes or printing inks. For this reason it is widely used in the textile printing industry in brushes for furnishing dye to the engraved printing roll. A single nylon-bristled brush can be used for many dye colors simply by washing after each run. Similarly, nylon has been used in brushes for applying glued labels to packages.

Small hand spotting brushes used in dry cleaning to remove spots from clothes are in constant contact with cleaning solvents, and are subject to considerable pounding and scrubbing. Hog bristles or tampico fiber generally used for spotting brushes rapidly became soggy. Spotting brushes made with nylon have been found to last almost four times as long.

The smoothness of nylon filaments has been reported to be a slight disadvantage in certain types of cleaning brushes where the brush is required to sponge up and retain water or other cleaning solutions. The filaments are so smooth that water quickly drains out of the brush. This is of little importance in applications where there is a constant spray of washing reagent.

Where high resistance to abrasion is required, nylon is preferable to natural bristle. Examples of this are the dye furnisher brush in the textile industry where the brush revolves at slow speed on the engraved printing roll, and sewage brushes, such as is shown in Fig. 2, used by the City of Milwaukee to clean solid refuse from a rotary metal screen. In this latter brush the average life of hog bristles was reported to be only one year. Wire brushes might have been substituted but then the wear on the screen would have been excessive.

The rug vibrator brush in the Hoover Model 60 vacuum cleaner, subject to severe abrasion at 3,000 r.p.m. as well as to considerable heat of friction, is made with nylon filaments which are claimed to last four times longer than horsehair formerly use. Nylon has also found extensive use in the porcelain enamel industry for removing dry enamel bisque from along the edge of the enamelware.

Nylon can be given many colors both by dyes and pigments. Selection of color is not always based upon appearance. For example, in the bottle washing industry where bristles are frequently cut off by jagged bottle edges and remain in the bottle after washing, the bristles are colored in contrast to the bottle so that broken-off bristles can be easily detected. Hence black is used for washing clear bottles, and white

filaments for brown or green bottles.

Nylon bristles are of uniform diameter and hence are not suitable for brushes which must have bristles with a flag or tapered end or both, such as required in paint brushes and certain special machine brushes. But this uniform diameter is highly desirable for rotary cleaning and polishing brushes.

Selection of Filament Size

There is no exact method for determining the correct diameter of filaments and the correct trim length. Selection of the diameter is usually made by comparing the stiffness of a sample nylon brush with the stiffness of a previous brush made with natural bristling material. In cases where no such comparison is available, such as in the design of a new machine, correct filament sizes can be determined only by intelligent guesswork and trial. Nylon monofilaments are available in diameters from 0.005 to 0.022 in., in steps of 0.001 in. Filaments used for most industrial brushes range from 0.009 to 0.020 in. dia., and those used for brushes in bottle washing machines range from 0.014 to 0.020 in. dia. Enamel edging brushes use 0.014-in. filaments.

Stiffness of a brush is decreased by tapered wear at the ends of the bristles. Abrasive wear causes natural bristles to taper down for a considable portion near the ends, consequently reducing stiffness. In contrast to this, nylon has been found to wear almost straight across the ends of the bristle, a factor which may account for its longer wearing qualities and effective stiffness. One manufacturer reports that he grinds the bristles of each nylon brush after trimming to smooth off jagged ends.

Core Materials

Selection of core materials and binding wire for nylon should be based upon the same considerations that dictate the adoption of nylon. The possibility that the synthetic bristle may outlive previously used core and binding materials should be borne in mind, and may make it advisable to specify more durable materials. Wood is ordinarily used as the backing material for industrial brushes. Kiln-dried maple is considered best for brushes used wet. Whitewood is the lightest and is the easiest to machine, so it is frequently specified for large orders of small brushes. Other woods used are walnut, dogwood, and birch.

In some applications where wood cores have deteriorated before the nylon bristles, substitution of metal such as aluminum alloy or brass has proved satisfactory. Molded plastic can also be used but for most industrial brushes the extra cost is prohibitive. Wood cores are the least expensive to machine, but for applications where the brush must be frequently rebristled or under conditions where wood deteriorates rapidly metal may be least expensive in the long run.

In bottle brushes, the constant rubbing of previously satisfactory brass or galvanized stem wire against the brush holder throughout the longer life of nylon has often caused the stem to break. Also, ordinary stem and tie wire discolors the nylon, giving a rusty appearance which looks unsanitary. These problems can be solved by using stainless steel wire.

Methods of Construction

Nylon can be fastened in the core by any one of the following methods: wire-drawing, stapling, wire twisting, vulcanization, continuous steel strip backing. Fig. 3 illustrates these methods.

Wire drawing consists of stitching the filaments with wire to a core through

GENERAL PROPERTIES OF NYLON MONOFILAMENTS

MELTING POINT . . . 264°C. (10-15 degrees lower in presence of oxygen).

DENSITY . . . 1.14.

REFRACTIVE INDEX . . . 1.55 ± 0.02, highly birefringent.

HEAT OF FUSION . . . 22 calories/gram.

SPECIFIC HEAT . . . 0.55 calories/degree. C./gram.

MODULUS OF ELASTICITY (E) . . .
At 0% relative humidity, 0.7 x 10^5 lbs./sq. in.
At 50% relative humidity, 0.45 x 10^5 lbs./sq. in.
At 100% relative humidity, 0.17 x 10^5 lbs./sq. in.

TENSILE STRENGTH (Diameters 7-20 Mils) . . . 50,000 lbs /sq. in.

ELONGATION TO BREAK . . . 30-35%.

ABRASION RESISTANCE . . . Far superior to hog bristle; tough rather than brittle.

MOISTURE ABSORPTION . . . 2.6% at 50% R.H.
7.6% at saturation.

ELECTRICAL PROPERTIES . . .
Power Factor . . . 2.0-3.5% at 1000 cycles, 20°C.
Dielectric Constant . . . 5 at 1000 cycles, 20°C.
Volume Resistivity . . . 10^{13} ohm/cm.^{3}.

SOLUBILITY . . . Soluble in cresol, phenol, formic acid and concentrated mineral acids.

EXPOSURE . . . Bristle properties unaffected by exposure conditions ranging from —14°C. to 65°C. and relative humidities ranging from 0 to 100%.

OXIDATION . . . Yellows slightly on long exposure at temperatures above 100°C. in presence of oxygen.

CHEMICAL RESISTANCE

Chemical Agent	Time of Exposure	Effect on Bristle Properties
Satd. sodium perborate soln.	24 hrs.	None
Satd. sodium perborate	14 days	Slight decrease in tensile and stiffness, abrasion resistance unaffected.
Hydrogen peroxide	24 hrs.	None
Toothpaste	6-12 mos. normal use	None, bristles slightly tinted by colored brands.
Trisodium phosphate, 10% soln.	3 wks.	None
Soda ash, 10% soln.	3 wks.	None
Trisodium phosphate and soda ash (1.1), 20% soln.	3 wks.	None
Sodium cyanide, 10.4% soln. (15oz./gal.)	7 days	None
Potassium carbonate, 19% soln.	2 mos.	None
Acetic acid, 5% soln.	2 mos.	None
Sulfuric acid, 5% soln.	7 days	None
Hydrochloric acid, 5% soln. at 100°C.	—	Slowly decomposes the nylon.
Sodium hydroxide, 1% soln.	2 mos.	None
Sodium hydroxide, 10% soln. at 85°C.	16 hrs.	None
Lard at 82°C.	5 days	None
Cottonseed oil at 82°C.	5 days	None

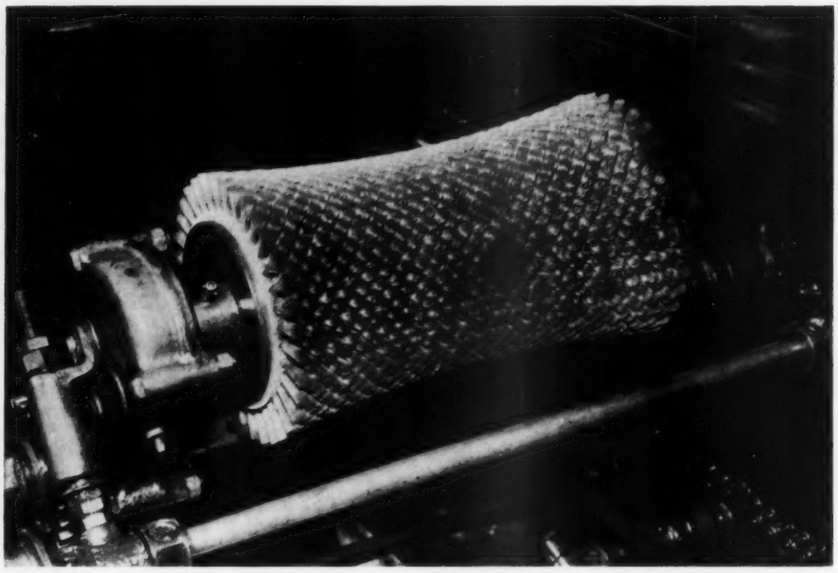


Fig. 2—In this brush used at the Milwaukee sewage disposal plant to sweep refuse from a metal filter screen, nylon monofilaments are wire-drawn into a wood core and trimmed to fit the contour of the revolving filter drum

which holes have been drilled. Filaments are supplied in 1½-in. dia. bundles in specified lengths from 1 1/6 in. up to 9 in. These bundles are sorted into smaller bundles which are folded into a U-shape the size of the tufts required. The wire is threaded up through the hole from the core back, through the U, back through the hole and the tuft is pulled tight in the hole. This is usually a hand operation, can be used on both large and small brushes with all types of backing, and is particularly suitable for applications where frequent re-bristling is required.

A slight variation of this method is that used in the rotary brush of the Hoover vacuum cleaner. Here the nylon filaments are inserted by machine into a die-cast aluminum back. The wire is in staple form and, as shown in Fig. 3, is bent over at the ends.

Stapling is generally used only with wood or soft plastic cores. Holes are drilled to a depth of about ¼ in. A hank of filament is folded into a U-shaped tuft which is inserted and fastened in the hole by a small wire staple. This operation can be performed automatically in high speed bristling machines on any size brushes and is considered the least expensive method.

The vulcanization method consists of drilling holes in the brush core, placing tufts of filaments in the holes with synthetic or rubber cement and heating in an oven until the cement has cured. This method imposes a definite limitation, for the fatigue resistance of nylon is reduced by exposure to high temperatures for long periods. This can be overcome by using a cement which will vulcanize at low temperature.

Fig. 3f shows a more recent method of constructing industrial brushes. Known as Steelgript, it consists of a continuous row of U-shaped filaments held in a crimped steel strip backing with a wire core. This single row construction is available in strips of any length, and can be bent to any desired shape. Rotary brushes are made from this strip either by winding it into a coil or by inserting rows of the strip around the periphery of a cylinder. Sections of worn filaments can be replaced simply by inserting new strips.

The Cost Factor

At the present time, the cost of nylon per pound is slightly higher than that of high grade China bristles. One factor which offsets this higher cost is the greatly increased life of the brush in certain applications. Another factor is that there is little waste when using nylon filaments. To obtain stiffness with natural bristles the butt and flag ends must be cut off. It is often necessary to trim as much as 1½ in. from a 4-in. China bristle.

Nylon's principle competition is with high-grade hog bristles. It is not expected to replace bristling materials used in cheap industrial brushes which now have a satisfactory life and which are dependent on large volume, low-cost sales. The specification of nylon in industrial brushes is probably a sound investment if it will outlast natural bristling materials to the point where its longer life more than offsets the higher initial cost, or if an expensive brush core warrants the extra cost of a more durable bristling material.

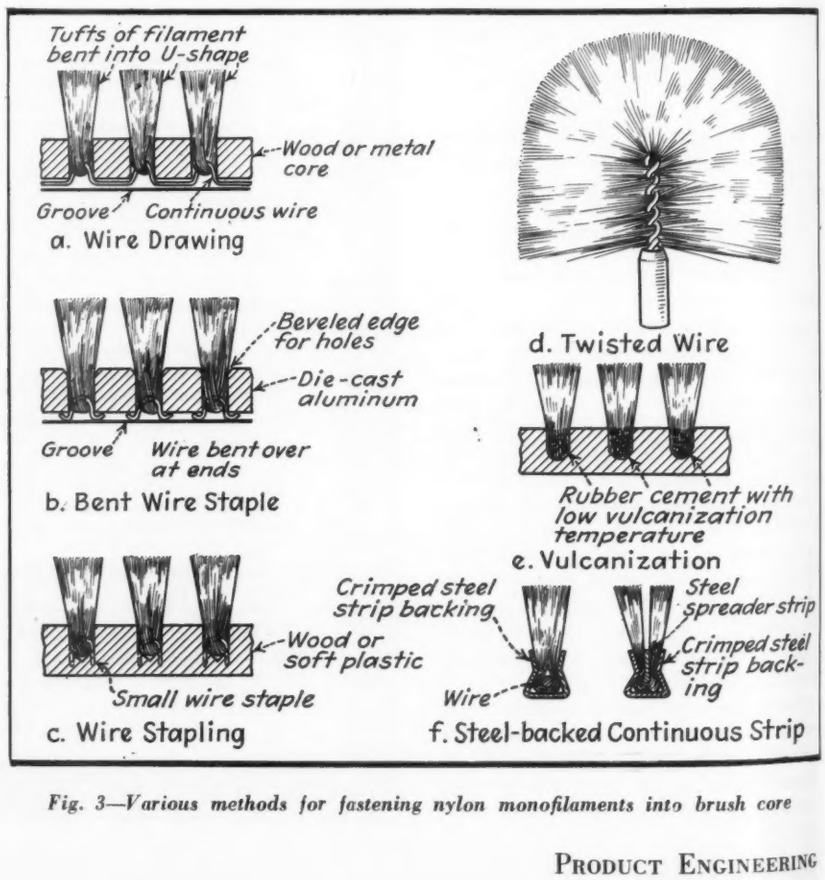


Fig. 3—Various methods for fastening nylon monofilaments into brush core

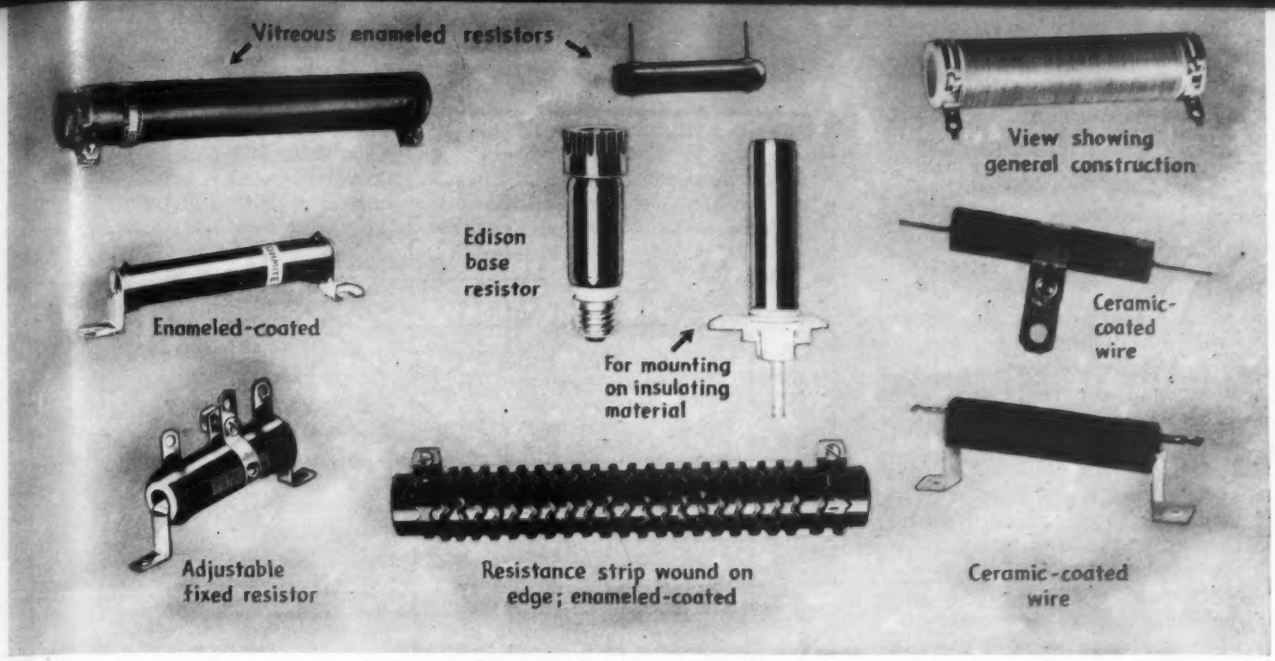


Fig. 1—Various available types of tubular wire wound resistors

FIXED RESISTORS

LEON PODOLSKY
Research Engineer, Sprague Products Company

SELECTION of fixed resistors for application in any electrical circuit, like any other design problem, involves many technical details and ramifications which require the careful attention of the designer and which may result in untold grief if neglected. But these fundamental considerations can be outlined, and by matching them against the characteristics of the various types available, as herein described, the problem of fixed resistor selection resolves itself into one of mathematics and adaptation of mountings.

When fixed resistors are required, the following ten factors must be checked:

Voltage drop across resistor, E volts
Current in resistor circuit, I amp.
Resistance value of resistor, R ohms
(Above factors follow Ohm's law)
Watts dissipated by resistor, P watts

$$P = I^2R \quad P = E^2/R \quad P = EI$$

Maximum permissible temperature rise of resistor and surrounding parts
Resistance tolerance (permissible variation from nominal value)
Humidity conditions
Method of mounting resistor, and nature of mounting surface
Potential between resistor and metal parts on which resistor is mounted
Noise level permissible in electronic amplifier circuits

Fixed resistors can be divided into two classifications: wire wound resistors and carbon composition resistors. The table above lists the general types. Precision instrument resistors are omitted from this classification.

Resistance Element	Form	Encasement
Wound Wire	Tubular	Cement Vitreous enamel Ceramic
	Strip	Plastic Metal
Carbon Composition	Molded stick	Varnish Plastic Ceramic
	Glass filament	Ceramic Plastic

Tubular Wire Wound Resistors

Wire wound resistors are generally considered to be the most stable and dependable. The general construction of tubular wire wound resistors, shown in Fig. 1, consists of a tubular ceramic core on which are mounted terminals and on which is wound a helix of resistance wire, most commonly a nickel-chromium alloy. The winding is coated with vitreous enamel or cement to hold the turns in place and to provide electrical insulation and mechanical protection. Resistance wires in this type are bare, and the turns must be carefully spaced to prevent short-circuiting. Bare wire limits the windings to a single layer.

More recently, a resistance wire under the trade name Koolohm has been introduced which is completely insulated with a material which maintains its insulating value at high temperatures. This insulated resistance wire can be closely wound and layer wound, and does not require overall coatings of cement or enamel for insulation. The resistor structure is encased in an extruded ceramic jacket.

Physical sizes of wire wound resistors are based on wattage dissipation and temperature rise. Underwriters' Laboratories and N.E.M.A. have standardized at 250 deg. C. the permissible temperature rise of resistors with embedded windings. The exact temperature rise of a resistor will depend on the air circulation, the mechanical construction, and the nature and color of the resistor surface. A temperature rise of 250 deg. C. when the resistor is suspended in free air permits dissipation of approximately 4.7 watts per sq.in. of surface of two-terminal tubular resistors. Fig. 2 shows approximate relationship of the temperature rise to wattage dissipation of a tubular resistor. Multiple tapped resistors have a somewhat lower wattage rating than two-terminal units of the same size.

Selection of wire size when bare wire is used is almost always dictated by the winding space and the resistance value required. Commonly used bare wire

sizes range in diameter from 0.001 in. to 0.032 in. or larger. Wires smaller than 0.002 in. in diameter should not be used where absolute reliability is required, particularly in the presence of high humidity.

Variation in resistance value is permissible in usual industrial applications. Standard commercial tolerance for wire wound units is 5 per cent. Resistors which require tolerance of 1 per cent or closer are classed as precision resistors and require special construction at higher cost.

The temperature coefficient of resistance will cause a rise in resistance of 3 to 7 per cent at full rated wattage, depending on the temperature reached by the windings and on the alloy used. Nickel-chromium alloys have a slight aging characteristic which produces a permanent change in resistance value of a few per cent after extended heating and cooling.

Corrosion or oxidation of the resistance wire will produce permanent changes in resistance value. This effect depends somewhat on wire size, for a given depth of attack on very fine wires will produce a much larger percentage reduction in cross section area and increase in resistance than in wires of large diameter. Pure nickel-chromium alloys are least susceptible to corrosion. Resistance wires with large percentages of iron, even though an increase in specific resistance is obtained with a consequent lowering of cost, should be avoided in conditions of high humidity or in the presence of corrosive fumes.

Cement, enamel, or ceramic jackets are needed to provide electrical insulation and mechanical protection to wire wound resistors. Cements used can be classed as organic and inorganic types. Organic cements are the most resistant to moisture, but are ordinarily limited to operation below 100 deg. C. This temperature is the limit of wattage dissipation so organic-cement coated resistors must be made larger than other types for a given wattage rating. Inorganic cement coatings can generally be operated without restrictions up to the full rated load temperature, but are not as moisture-resistant.

In vitreous enamel coatings the enamel slurry is applied to wound units by dipping or spraying. The coating is then dried and vitrefied in furnaces at 775 to 880 deg. C. Enamel coatings have no temperature limitations up to the full rating of the resistor, but are in general more hygroscopic.

Ceramic outer jackets on resistors are a newer and improved method of providing mechanical protection and secondary insulation for resistor windings. Ceramic-coated resistors can be attached to metal chassis or mountings without danger of short-circuiting or grounding. Ceramic jackets are heat proof and can be made of material having little moisture absorption.

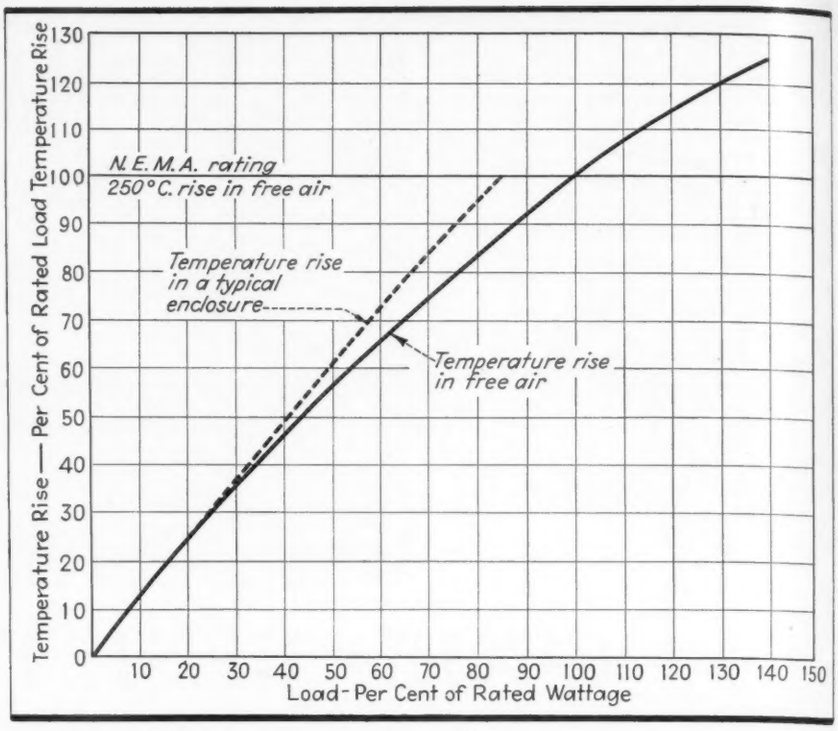


Fig. 2—Curve showing relationship of temperature rise to wattage dissipation

Standard terminal constructions, shown in Fig. 3, are lugs or wire pigtails. The lugs can be designed to take screws or special hardware. Wire pigtails can be stranded or solid, as required. Tapped resistors, with multiple terminals, are also standard construction in vitreous enameled and cement coated resistors.

Terminals must withstand the firing temperatures of enamel or cement coatings and consequently must be of such metal as to be resistant to oxidation at these temperatures. Copper, monel, and nickel are commonly used. Copper terminals usually require cleaning and tinning after the firing operation.

Variable contact resistance in the joints between the wire of the resistor windings and the external terminals can cause erratic performance of the resistor. These joints are also highly susceptible to corrosion and electrolytic effects where dissimilar metals are joined. Silver soldering is the most practical and reliable means of making soldered connections on resistors.

One terminal construction which gives a rigid, low-resistant contact consists of a cast metal cap or ring which embeds ends of resistor windings and terminal lug or wire. Metal used must have a sufficiently high melting point to avoid softening or creeping.

In mounting cement covered and vitreous resistors care must be exercised to avoid bringing the surface near metal parts at high potential with respect to the resistor circuit. These units are usually mounted rigidly by through-bolts, or by the use of mounting feet inserted in the center bore of the resistor tube. Fig. 3 shows these mountings. When through-bolts are used, caution is needed to avoid short circuiting or grounding the resistor terminals with the bolt heads or washers. Resistor terminals are usually indented from the tube edge, as shown in Fig. 3, to leave an insulating length of ceramic tube. If high voltages are involved, ceramic or mica insulating washers on the resistor ends or extra indentation of the resistor terminals should be used.

Where ceramic outer casings are provided, small units are usually so constructed that they can be mounted directly by the wire pigtails or clamped to chassis or frame. Higher wattage units can be mounted by clamps or mounting feet to metal surfaces.

Strip Resistors

Strip resistors provide an economical solution to some resistor problems where relatively low wattages are involved, particularly when multiple tapped units are required. Fig. 4 shows Common strip resistor constructions. One of these is completely metal clad,

another is of the plastic molded type with a metal mounting bracket which acts as armor on one side, and the third is a vitreous-enamel plague. In both of the first two types, the resistance winding is placed on flat plastic or fiber strips, and is terminated by clamping fingered parts of the terminal lugs around the windings or by connecting the winding ends to lugs fastened to the winding form.

Wattage dissipation of the two strip resistors is limited by the organic insulating materials and winding forms used, with 100 deg. C. the maximum permissible temperature. Wattage dissipation is achieved by fastening strip resistors tightly against chassis or other flat metal surfaces which act as heat radiators. Prevent this conducted heat from affecting other parts.

The various widths of strip resistors are usually rated by wattage per linear inch of resistor. This rating varies with construction, and is strictly based on the resistor mounted to metal.

Carbon Composition Resistors

The application of carbon composition resistors is chiefly to electronic circuits and apparatus, and has found its principal usefulness in radio work. In general, they are recommended only for applications where wattage dissipation does not exceed 2 watts and resistance stability is not required to be better than 10 per cent. Two general classifications of carbon composition resistors are the molded stick resistor and the coated filament resistor.

The molded stick resistor consists of a cylindrical rod formed under high pressure by molding or extruding a compound containing dispersed carbons, and hardening by baking. The resistance of the rods varies approximately inversely with carbon content. Terminal bands are formed on the resistor sticks by spraying molten metal bands around the ends and soldering lead wires to these bands, or by pressing metal caps over the ends of the sticks to which the leads are attached. A more recent construction has the lead wires molded into the resistor stick.

Molded stick resistors can be impregnated to moisture-proof them, after which they can be finished with a coating of varnish or lacquer or completely encased in a jacket of molded plastic. A further variation is to encase the resistor in a tubular ceramic jacket. Fig. 5 shows these constructions.

Coated carbon filament type resistor consists of a glass filament on the surface of which is deposited a coating of carbon composition. The resistance per unit length of filament is determined by the carbon content of the coating. This filament may be in solid form with the carbon coating on the outside, or in tubular form with the resistance material on the inside.

Two common finishing procedures are used with this construction. The conducting filament may be slipped through the bore of a ceramic tube, lead wires attached to the filament ends, and a cast cap of type metal poured around the ends to securely join the filament, lead wire, and ceramic tube. Or the filament and lead wire connections may be encased in plastic.

Wattage ratings of both types of carbon composition resistors have been determined somewhat by the temperature limitations of the materials involved. Four wattage sizes, ¼, ½, 1, and 2 watts have been standardized by the Radio Manufacturers Association. The physical size of these units varies somewhat with the manufacturer, but approximates dimensions given below.

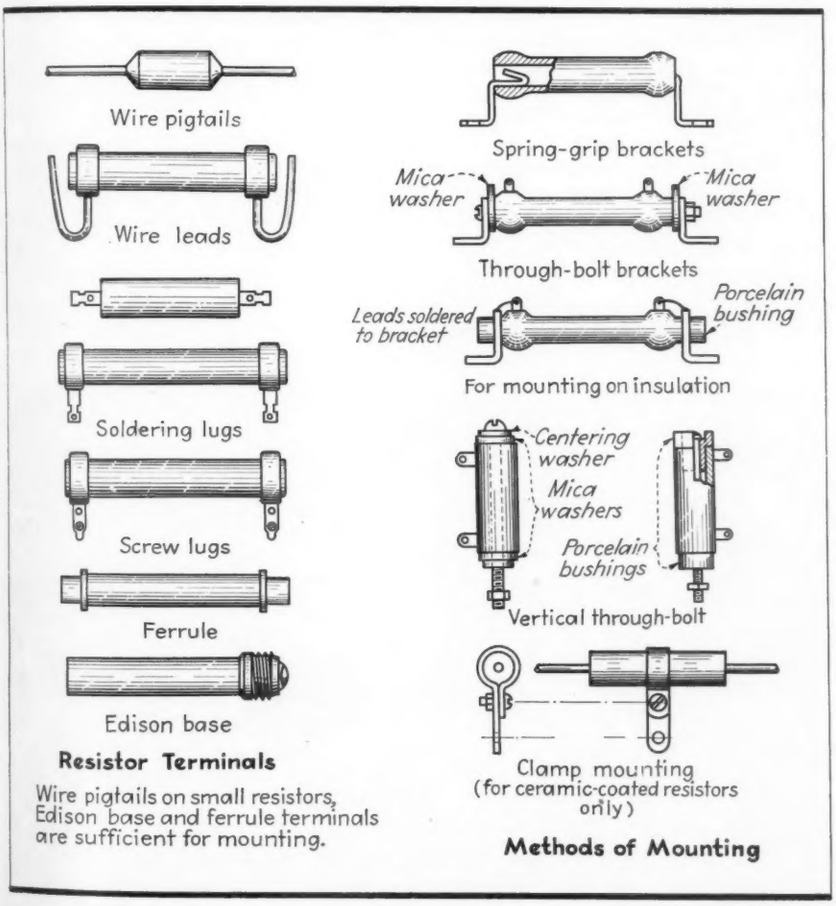


Fig. 3—Terminal constructions and methods of mounting tubular resistors

Rating in Watts	Overall Size in In.	Max. r.m.s. Volts
¼	¾ x $\frac{9}{32}$ Dia.	200
½	$1\frac{1}{16}$ x $\frac{3}{8}$ Dia.	350
1	$1\frac{13}{16}$ x $\frac{13}{32}$ Dia.	500
2	$2\frac{1}{16}$ x ½ Dia.	500

Maximum root mean square voltage limitations for these units are shown in the table. When a certain resistance and wattage rating requires a voltage which exceeds the values shown, larger units or multiples must be used.

Carbon composition resistors are manufactured in any standard resistance rating from 5 ohms to 20 megohms. Values lower than 5 ohms and higher than 20 megohms require special treatment. Glass filament construction is available in very high resistances, of the order of thousands of megohms, for use as high resistance standards in electronic apparatus. The maximum practical resistance of the molded rod is 100 megohms.

Decreasing resistance with either increasing voltage or temperature is characteristic of carbon composition resistors. In modern constructions, these effects are small, usually less than 5 per cent decrease in resistance between the readings taken at 1/10 rated voltage and full rated voltage, and 5 per cent decrease in resistance

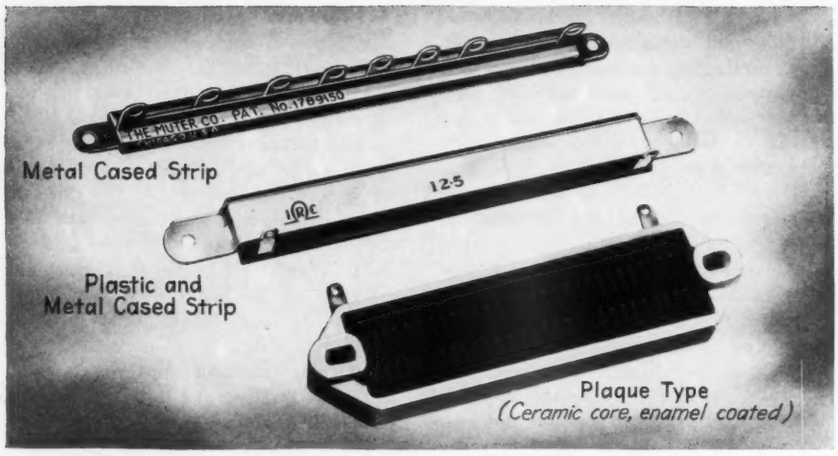


Fig. 4—Strip and plaque resistors of the wire wound type

between readings taken at room temperature and at rated wattage dissipation. These effects are more pronounced in higher resistance values and are cumulative, so that a total change of 10 per cent may occur.

Carbon composition resistors are very sensitive to absorbed moisture, but unlike other semi-conductors, resistance increases with moisture absorption. They must be carefully dried and impregnated. Types encased in molded plastics or ceramic have the greatest resistance stability.

Aging, or drift in resistance value with time, in carbon composition resistors can be caused by absorbed moisture. Under the best conditions resistance stability of 10 per cent over extended periods of time can be expected.

Standard initial resistance tolerances for carbon composition resistors are plus or minus 5, 10, and 20 per cent from nominal value. This rated tolerance applies only to initial resistance value; the variations caused by voltage, temperature, and humidity may produce further deviations.

Typical Resistor Calculations

EXAMPLE 1. A relay coil designed to operate at 115-volt d.c. must be operated from a 230-volt circuit. The current drawn by the relay coil is 0.5 amp. and may fall to 0.45 amp. before unreliable operation occurs. It is desired to place in series with the relay coil a resistor of such type and value as will permit satisfactory operation from the 230-volt circuit.

The resistance of the relay coil is:

$$R = \frac{E}{I} = \frac{115}{0.5} = 230 \text{ ohms}$$

Total resistance required in circuit:

$$R = \frac{E}{I} = \frac{230}{0.5} = 460 \text{ ohms}$$

The external resistor must have

$$460 - 230 = 230 \text{ ohms}$$

Resistance tolerance, which is the same as the per cent permissible variation in relay current:

$$\frac{0.5 - 0.45}{0.5} \times 100 = 10 \text{ per cent}$$

Wattage dissipation will be:

$$P = I^2R = (0.5)^2 \times 230 = 57.5 \text{ watts}$$

A wire wound resistor should be specified. If the full temperature rise of 250 deg. C. of standard wire wound resistors is permissible, a 60-watt resistor will be specified. Where some lower temperature rise must be set, a close approximation of the wattage rating of the resistor to be specified can be obtained by reference to Fig. 2. For example, if the temperature rise is to be limited to 100 deg. C. this is (100/250) = 40 per cent of full rated temperature rise. The chart shows that 40 per cent of full rated temperature rise will be produced by 46 per cent of full wattage rating. A resistor wattage rating of which 57.5 watts is 46 per cent, or 125 watts, must be specified to obtain a 100 deg. C. temperature rise.

EXAMPLE 2. A neon pilot lamp draws a current of 0.001 amp. when operated at its rated voltage of 230 volts. It is desired to operate this pilot lamp on a 550-volt circuit. To accomplish this, a resistor must be placed in series with the pilot lamp on the 550-volt circuit.

The voltage drop across the resistor must be:

$$550 - 230 = 320 \text{ volts}$$

The lamp current is 0.001 amp. The series resistor must have a value of:

$$R = \frac{E}{I} \quad \frac{320}{0.001} = 320{,}000 \text{ ohms}$$

The wattage which will be dissipated by the resistor will be:

$$P = \frac{E^2}{R} = \frac{320^2}{320.000} = \frac{102{,}400}{320{,}000}$$

$$= 0.32 \text{ watt}$$

A ½-watt resistor will be adequate for the application. Since the operating voltages and currents of ordinary neon lamps are not critical and may vary as much as 10 per cent, a carbon composition resistor is satisfactory.

ILLUSTRATIONS in this article appear through the courtesy of Sprague Products Company, Ward Leonard Electric Company, International Resistance Company, Ohmite Manufacturing Company, The Muter Company, Stackpole Carbon Company, Allen-Bradley Company, and Erie Resistor Corporation.

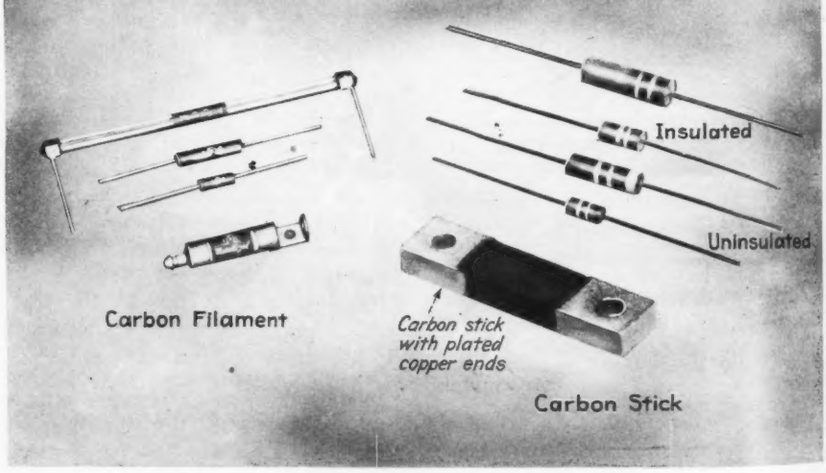
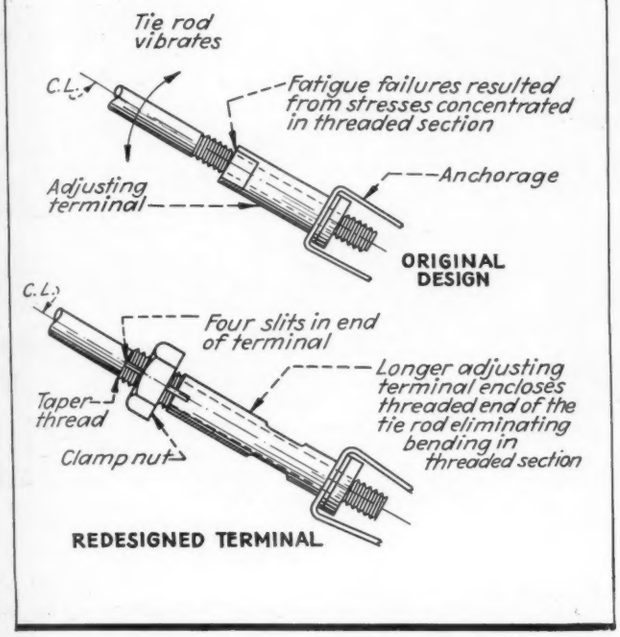


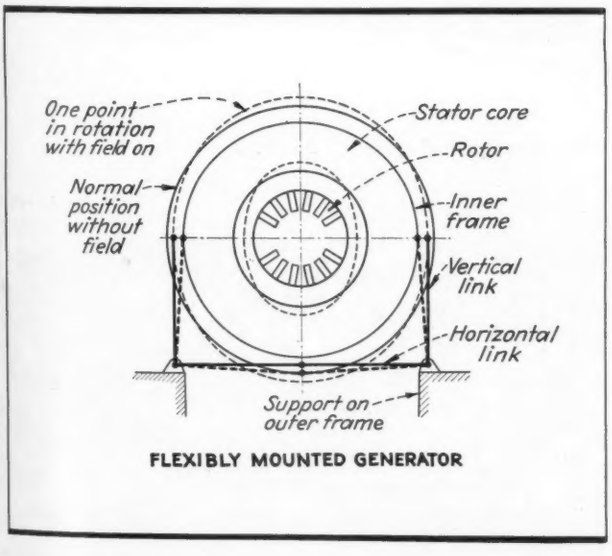
Fig. 5—Coated filament and carbon stick type carbon composition resistors

CAUSES AND CURES

PRODUCT ENGINEERING will pay $3 for each example published in Causes and Cures. Where illustrations are necessary, include drawings, rough sketches or photographs



Fatigue failures in threaded tie rods bracing the tail surfaces of an airplane resulted from stress concentration in the root of the threads as a result of vibration of the tie rods. To eliminate this stress concentration a longer terminal was designed, the end of which covers the threaded section of the rod. A clamping nut is run up on the tapered thread so that the terminal grips the solid shank.



High-wattage street lamps had smooth aluminum reflectors which reflected heat rays back through the focal axis, setting up high temperatures which caused lamp to burn out. So General Electric's Lynn laboratory developed this reflector with steps or flutes which reflected rays slightly to one side of the stem. By attaching thermocouples a reduction in stem temperature of 278 deg. F. was found.

Stators of large two-pole electrical machines assume slightly elliptical shapes, caused by tremendous magnetic pull of field poles. This elliptical shape, only a few thousandths of an inch out-of-round, revolves with the rotor, creating a movement transmitted to foundations as annoying vibration. Westinghouse engineers eliminate this with an ingenious flexible mounting. Stator is supported on two sets of links as shown. One set permits horizontal but not vertical motion, the other permits vertical but not horizontal motion. Sum total is no motion at all where links rest on foundation.

CHROMIUM-PLATING aircraft engine cylinders resulted in a surface so smooth that oil would not adhere to it. Piston rings wiped the cylinder clean of oil on each down stroke. Engineers wanted the wearing advantages of hard chromium, so they looked for a method to give the surface oil-retaining properties. Solution was to plate the cylinder to a coating thickness slightly greater than required, then reverse the current for a short period and "strip" the surface, leaving minute pores in the chromium. Surface is hard and smooth, but oil adheres and the lubricating film can be maintained.

PERMANENT MAGNETS IN ELE

Cast or sintered aluminum-nickel alloy high-coercive magnets are being used in ever-increasing numbers to replace bulky, current-consuming wound magnets which require wire leads or commutators, and to replace heavier and shorter-lived chromium-steel or cobalt-steel magnets. For determination of desired magnetic values see PRODUCT ENGINEERING, April 1937, p. 122–125; May 1937, p. 181–183; June 1937, p. 220–221. Grinding is the only practical machining method. Wherever possible use magnets of uniform cross-section which can be cast in long bars, centerless or surface ground as required and cut off to length by abrasive saw. Fastening methods should require a minimum of grinding. Sintered magnets can be molded accurately, and holes can be cast accurately by using graphite cores.

Fig. 1—Scintilla magneto has two cast and ground magnets in its simple rotor construction. The solid magnets are held by clamping them between the rotor laminations and end plates.

Fig. 2—In the die-cast rotor assembly of the Wico Electric Company magneto the laminated rotor shoes are tightly riveted together, magnets are placed between them, and aluminum alloy is cast around them. Die-cast unit is mounted on shaft by an end plate screwed into holes tapped in the die-casting metal. Lubricating oil circulates around the shaft within the rotor.

Fig. 3—The motor of the electric tachometer indicator of Kollsman Instrument Division is electrically driven in synchronism with a small generator, mounted on and driven by the engine. On the motor shaft extension is mounted a 4-pole permanent magnet which revolves within a cup. Eddy currents set up in the cup by the revolving magnet tend to rotate the cup, which is restrained by a hairspring. Amount of rotation of cup depends on speed of the magnet, thus upon speed of the engine.

Fig. 4—Tunnel-type aluminum-nickel alloy magnet is used to achieve high power in this Varney miniature locomotive model motor. Wide skirted pole pieces eliminate tendency toward rough operation at slow speeds. These cast magnets were formerly internally ground for accuracy, but are now cast to tolerances of a few thousandths of an inch by using graphite rod cores. The magnet is powerful enough so that a relatively wide air gap is permissible.

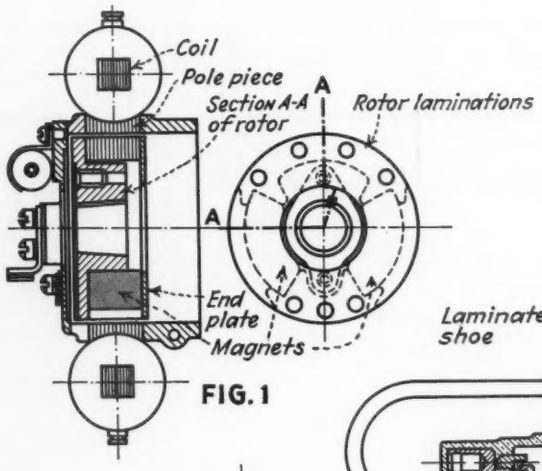


FIG. 1

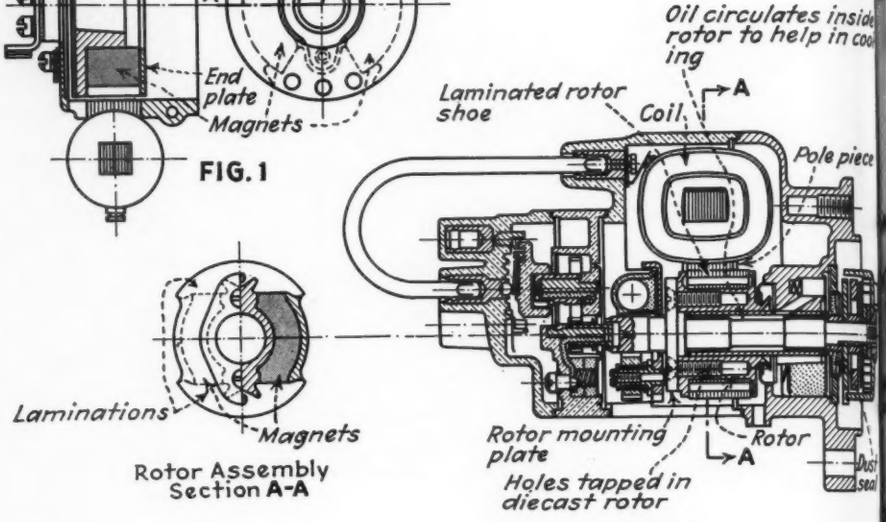


FIG. 2

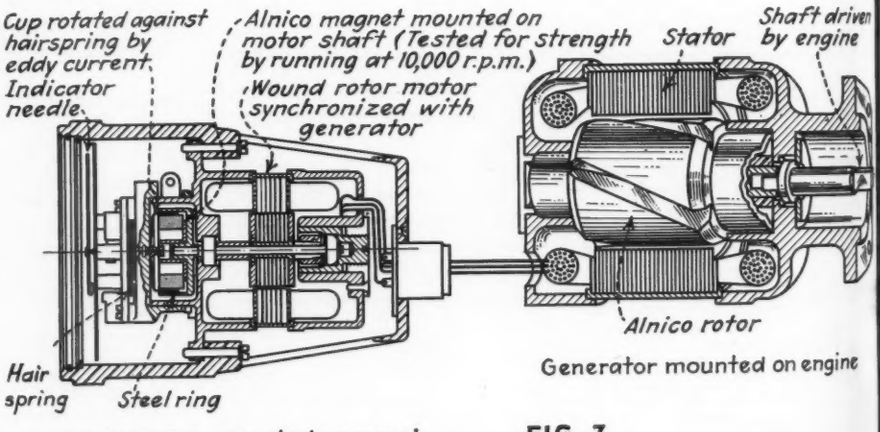

Cup rotated against hairspring by eddy current
Indicator needle
Alnico magnet mounted on motor shaft (Tested for strength by running at 10,000 r.p.m.)
Wound rotor motor synchronized with generator
Stator
Shaft driven by engine
Alnico rotor
Generator mounted on engine
Hair spring
Steel ring
Tachometer mounted on panel

FIG. 3

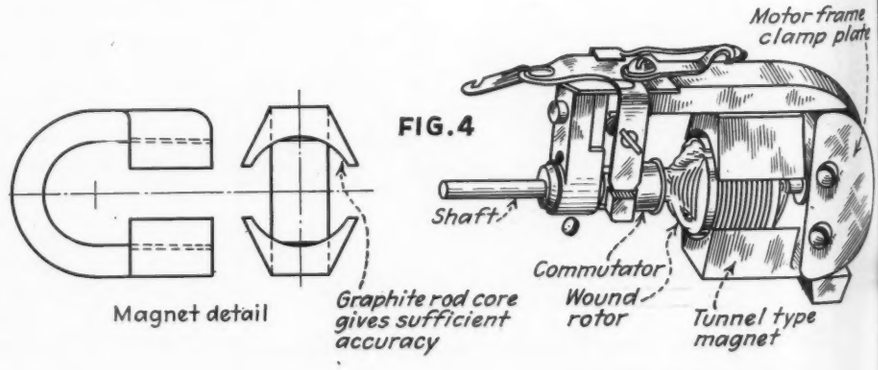


FIG. 4

ELECTRICAL APPLICATIONS

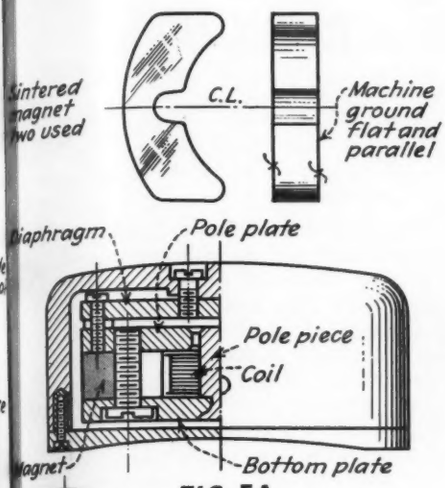


FIG.5A

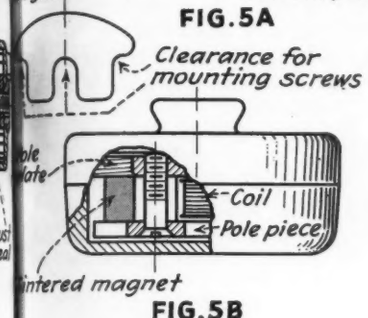


FIG.5B

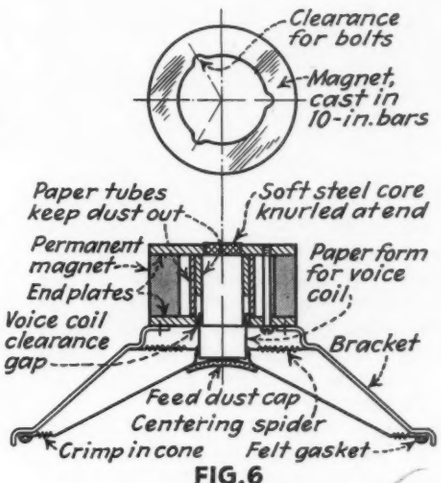


FIG.6

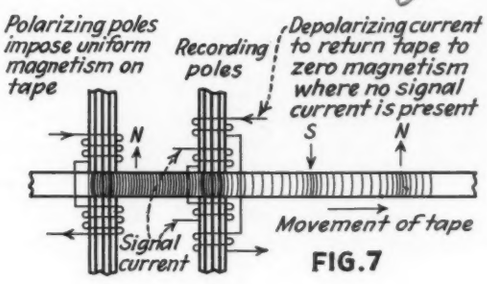


FIG.7

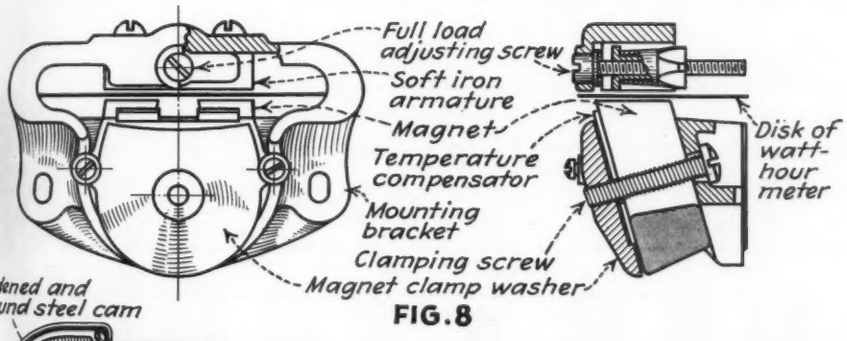


FIG.8

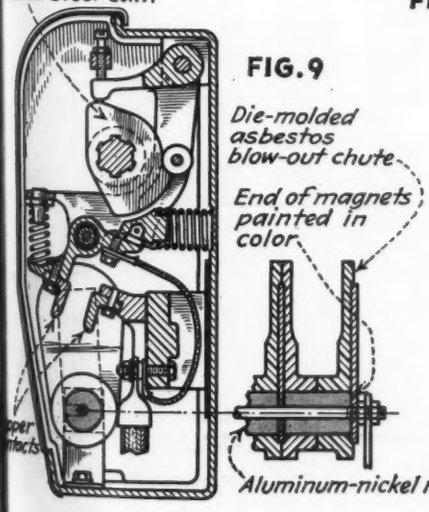
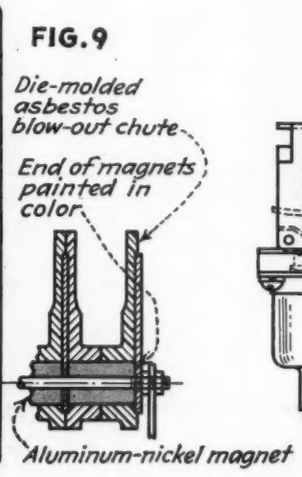


FIG.9



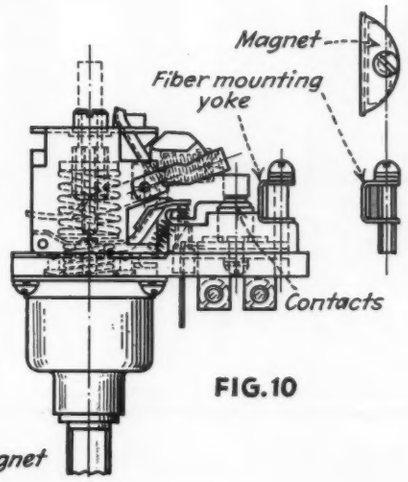


FIG.10

Fig. 5—Tiny sintered aluminum-nickel-cobalt permanent magnets are used in these Sonotone Corporation micro-midget hearing aids. Weight and size are of paramount importance. Polarity of the magnets is transverse, with poles at flat surfaces top and bottom. Molded accurately to size, the only grinding necessary is on the pole faces.

Fig. 6—Typical ring-type cast permanent magnets in Cinaudagraph radio speakers. Magnet material is cast as a long cored cylinder. Only machining is cut-off with abrasive saw.

Fig. 7—Permanent magnet in tape form is used for permanent sound recording. The tape, as shown in this schematic set-up, passes between two sets of poles and is magnetized either through its thickness or width by the sound current. Tape is made of a new alloy called Vicalloy consisting of 40–60 per cent cobalt, 5–20 per cent vanadium, balance iron. This alloy can be rolled, drawn, welded, machined, and has a coercive force as high as 400 oersteds.

Fig. 8—Aluminum-nickel permanent magnet replaced two chromium-steel magnets in this damping unit for Duncan watt-hour meters, giving longer accurate life and simpler construction. Magnets are cast in horseshoe shape, with grinding only on pole faces. Temperature compensation is effected by placing on the side of the magnet a thin sheet of a metal which has a negative temperature coefficient of permeability. Magnetic field is adjusted by varying the gap between magnet and soft iron armature.

Fig. 9—Blow-out magnets on the Yale & Towne Cam-O-Tactor for industrial trucks prevent arcing of contacts when interrupting currents as high as 500 amp. High-coercive permanent magnets in place of electromagnets save space and eliminate the objectional drop in voltage across electromagnets. Magnets are cast with cored hole which is slipped over bolt in blow-out assembly.

Fig. 10—Arc blowout magnet of aluminum-nickel alloy is mounted directly beside contacts of this Cutler-Hammer refrigerator control. No machining is necessary; the casting is cadmium plated before magnetization. Main considerations are permanence of operation and conservation of space.

FATIGUE STRENGTH—II

Of Members as Influenced by Surface Conditions

O. J. HORGER, *Director, Railway Engineering and Research*
The Timken Roller Bearing Company

EFFECTS on fatigue limits of members caused by various types of surface finishes ranging from rough turned to superfinishes were discussed in Part I of this article, which appeared in the November number of PRODUCT ENGINEERING. The present installment will deal with the effect on fatigue endurance of operations such as burnishing, rolling and press-fitting. The influence of surface conditions on fatigue of members under torsional loading will also be discussed.

Burnishing machine parts by passing a hardened roller under pressure over a surface or by pressing a ball through an undersize hole are old methods of obtaining smooth and wear resisting surfaces. It has been only about ten years, however, since the first experimental evidence was submitted to show that burnishing also produced a surprising increase in fatigue strength. During this decade various investigators have confirmed and extended earlier findings. Today much practical use is being made of this knowledge in various commercial applications.

Some examples of increased rotating bending fatigue strength obtained by surface rolling of 0.3 in. dia. plain specimens are shown in Fig. 6. Note that the fatigue strength increases with increased rolling pressure despite the fact that the higher roller pressures produce greater irregularity of surface finish. A point can be finally reached where very little additional increased fatigue strength is obtained with an increase in rolling pressure, this maximum increased strength is about 30 per cent above that for the unrolled bar.

The method of rolling the specimens is shown in Fig. 7, three equally spaced rollers under spring pressure are contained in a cage mounted in the tool post which is fed along the shaft. Using a multiple number of rollers has an advantage in that the roll pressure is not imposed on the lathe centers, also one or two of the rollers can be provided with a relatively sharp contour radius in order to produce great penetration of work hardening in the shaft, and yet another roller can have a flat contour to give a smooth surface. Sufficient roller pressure is applied to produce plastic flow of the metal under the roller, this is evidenced by a small wave of metal flowing ahead of the roller. The structure shown in Fig. 8 was obtained by surface rolling a specimen of S.A.E. 1045 normalized and tempered steel.

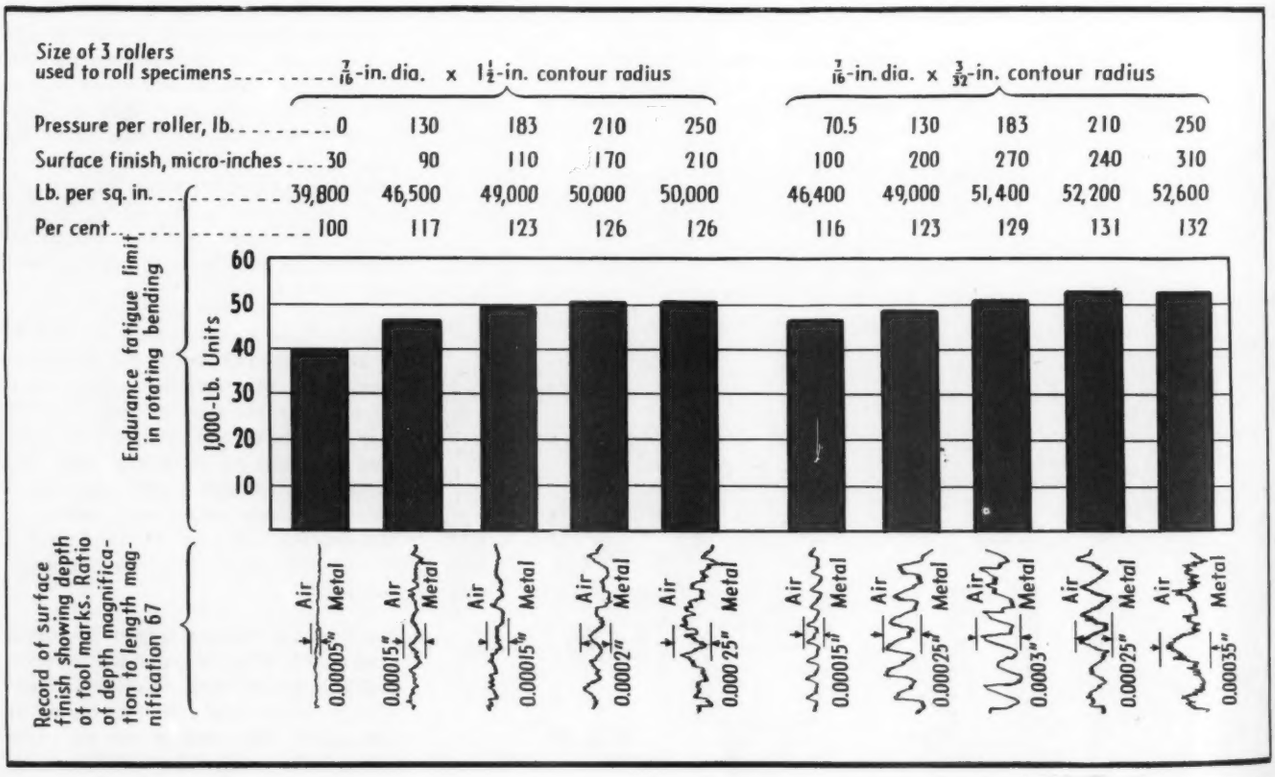

Size of 3 rollers used to roll specimens
7/16-in. dia. x 1½-in. contour radius
7/16-in. dia. x 3/32-in. contour radius
Pressure per roller, lb. 0 130 183 210 250 70.5 130 183 210 250
Surface finish, micro-inches 30 90 110 170 210 100 200 270 240 310
Lb. per sq. in. 39,800 46,500 49,000 50,000 50,000 46,400 49,000 51,400 52,200 52,600
Per cent 100 117 123 126 126 116 123 129 131 132
Endurance fatigue limit in rotating bending
1,000-Lb. Units
60
50
40
30
20
10
Record of surface finish showing depth of tool marks. Ratio of depth magnification to length magnification 67
Air
Metal
0.00005"
0.00015"
0.00015"
0.0002"
0.00025"
0.00015"
0.00025"
0.0003"
0.00025"
0.00035"

Fig. 6—Endurance fatigue limits in rotating bending of 0.3 in. dia. specimens after surface rolling at various pressures. Roller used for left-hand group has a 1½ in. contour radius, roller used for right-hand group has a 3/32 in. contour radius

Results of similar fatigue tests, shown in Fig. 9, on shafts of 1 and 2 in. dia. at various rolling pressures, indicate an increase in fatigue strength similar to that for the 0.3 in. members in Fig. 6. Further investigation on 6 in. axles indicate similar conclusions.

The foregoing discussion of rolling was concerned only with plain specimens in which there were no stress concentration factors such as fillets, notches, or press-fitted members. In specimens having stress concentration shapes, however, the per cent increase in endurance limit obtained by surface rolling was greater than that for the plain specimens in Figs. 6 and 9. The method of rolling a fillet is shown in Fig. 10, the tool supports a single roller which is made to traverse the fillet while the axle rotates.

Fillet rolling applied to $1\frac{1}{8}$ in. shafts having a 0.40 in. radius fillet connecting a $\frac{7}{8}$ in. diameter shoulder gave the values listed in Table II, (See "Danger of Fatigue on Grooves of Shafts and Axles and its Diminution," by A. Thum and E. Bruder, in *Deutsche Kraftfahrforschung*, Number 11, 1938.) In this test the notch effect of the fillet was largely offset by the influence of fillet rolling. Other sizes of fillets were also investigated in which the results showed that rolling improves the en-

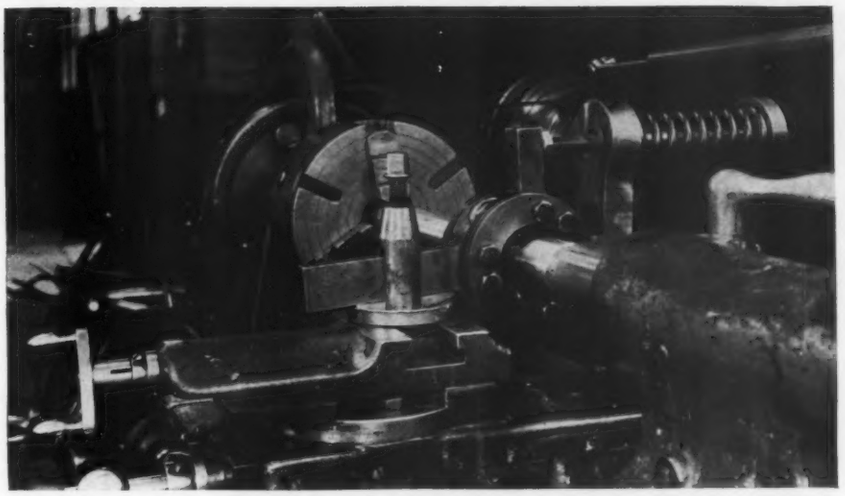


Fig. 7—Surface rolling a shaft with three equally spaced rollers held under spring pressure in a cage mounted on tool shank. With this multiple roller arrangement the danger of putting pressure on lathe centers during rolling is avoided

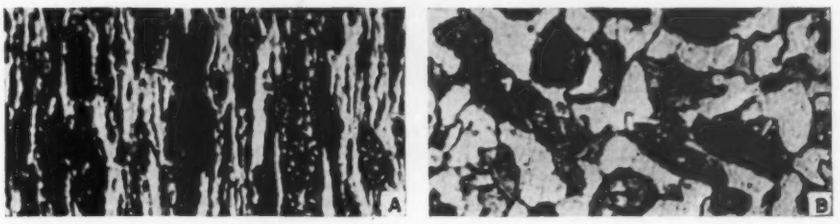


Fig. 8—Photomicrograph (magnification 1,000) of structure obtained by surface rolling an S.A.E. normalized and tempered steel. (A) New surface. (B) Below surface

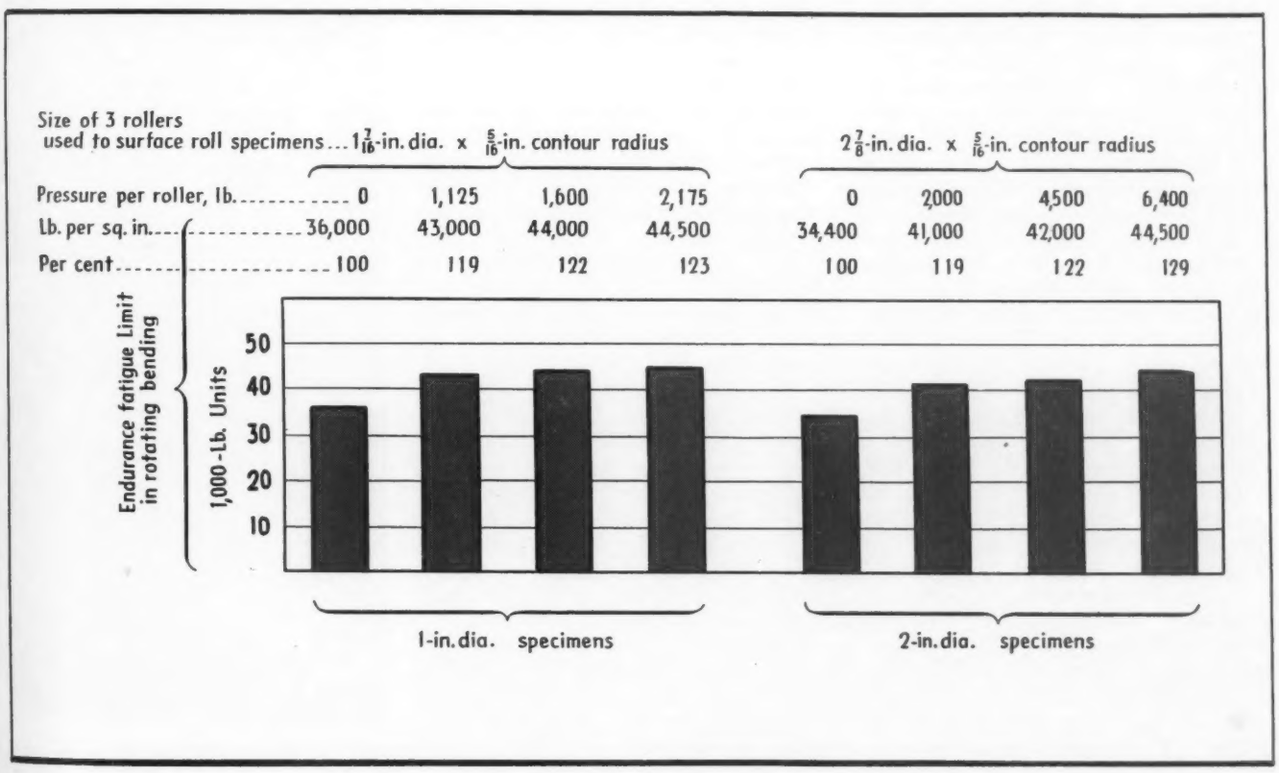

Size of 3 rollers used to surface roll specimens
1 7/16-in. dia. x 5/16-in. contour radius
2 7/8-in. dia. x 5/16-in. contour radius
Pressure per roller, lb. 0 1,125 1,600 2,175 0 2,000 4,500 6,400
Lb. per sq. in. 36,000 43,000 44,000 44,500 34,400 41,000 42,000 44,500
Per cent 100 119 122 123 100 119 122 129
Endurance fatigue Limit in rotating bending
1,000-Lb. Units
50
40
30
20
10
1-in. dia. specimens
2-in. dia. specimens

Fig. 9—Increase in fatigue strength by surface rolling 1 and 2 in. dia. shafts of S.A.E. 1045 normalized and tempered steel at various rolling pressures. Further investigations of 6 in. dia. axles indicate similar conclusions

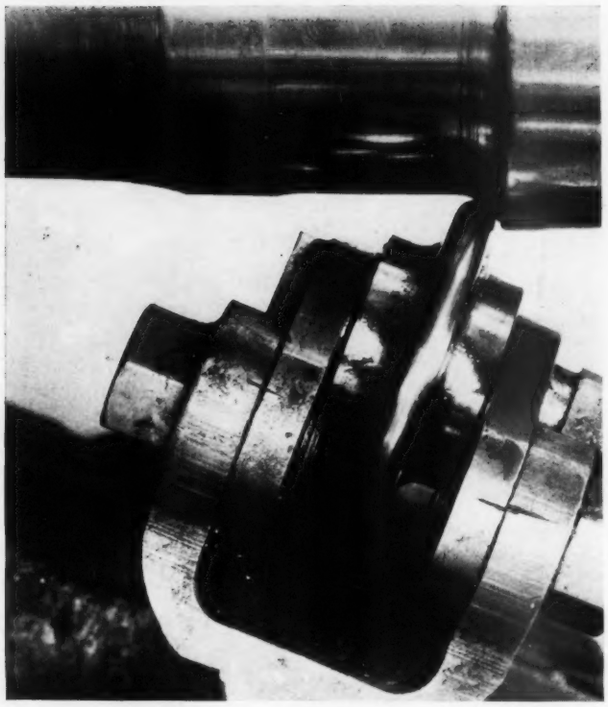


Fig. 10—Surface rolling 1/8 in. fillets on a 5 in. shaft

Table II—Endurance Limit in Rotating Bending

	Lb. per sq. in.	Per cent
Shaft without fillet, polished	56,900	100
Shaft with rolled fillet	50,000	87
Shaft with polished fillet, not rolled	29,700	52

Table III—Effect of Rolling Shaft at Wheel Seat*

Axle Without Press-Fitted Wheel	Endurance Fatigue Limit in Rotating Bending	
	Lb. Per Sq. In.	Per Cent
Polished	34,400	100
Smooth Turned	13,000	38
Rolled Finish	35,000	102
Flamed Hardened	45,000	131
Metal Sprayed	21,000	61

* For press-fitted wheel on 2 in. axles of normalized and tempered S.A.E. 1045 steel.

durance limit of the specimens in rotating bending.

The piece shown in Fig. 11 is a quenched and tempered alloy steel member about 5 in. dia. which when subjected to alternate tension and compression loading developed fatigue failure in the base of the 1/8 in. fillet. A number of such failures occurred in service after a few months operation. After rolling the fillet, however, without any changes in design, no further failures were encountered to date in a period extending over two years.

It is common practice to roll the key seat portions of aircraft and automobile engine valve stems to prevent fatigue failures which might otherwise occur in that section. Transverse holes in crankshafts and other members are also potential sources of failure which initiate at the edge of the hole. By pressing with specially shaped blocks against the shaft in the immediate region of the hole an increase of 38 per cent and higher in fatigue strength has been obtained. (A. Thum and W. Bautz, "Increasing the Fatigue Strength of Notched Members by Residual Stresses," *Zeitschrift des Vereines deutscher Ingenieure*, Vol. 78, Number 31, August, 1934). Screw threads also have been improved by as much as 100 per cent in fatigue strength by rolling. (W. Staedel, Fatigue Strength of Threads, *Mitteilungen des Material-prüfungsantalt* an der Technische Hochschule Darmstadt, Vol. 4, 1933). The threads are rolled only in the bottom portion so as to compress the material in the critically stressed region without influencing the thread engagement. Also, the eye ends of rods having 1 3/8 in. holes were increased 50 per cent in fatigue limit by rolling the surface of the hole.

Often surface rolling can not be applied to cold work the surface of intricately shaped members. Highly stressed coil springs and also rear axles for automobiles sometimes are shot blasted to improve their fatigue strength.

Press or shrink-fitted wheels, pulleys, gears, and bearings decrease the fatigue strength of axles. A typical fatigue fracture in a shaft to which is clamped a split pulley is shown in Fig. 12. Table III shows how rolling seats on 2 in. axles, of normalized and tempered S.A.E. 1045 steel, increased their resistance to the stress concentrations that are present in press-fitted wheels.

The high stresses necessary to test, for fatigue strength in rotating bending, axles as large as 11 1/2 in. dia. which had been rolled in the wheel fit caused tightly pressed-on wheels to loosen without breaking the axle. In other tests unrolled identical axles broke off in the wheel fit without loosening the wheels.

Under alternate torsional loading the influence of surface conditions on fatigue is much greater than under

Fig. 11—Fatigue failure of 5 in. dia. shaft which originated at base of 1/8 in. fillet. This condition was later corrected by surface rolling fillet

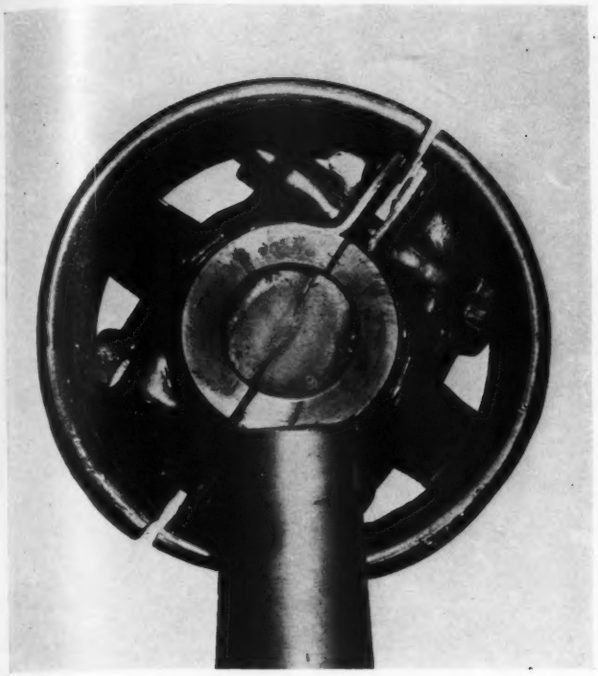


Fig. 12—Fatigue fracture caused by clamping effect of split pulley which decreased the fatigue strength of the steel shaft

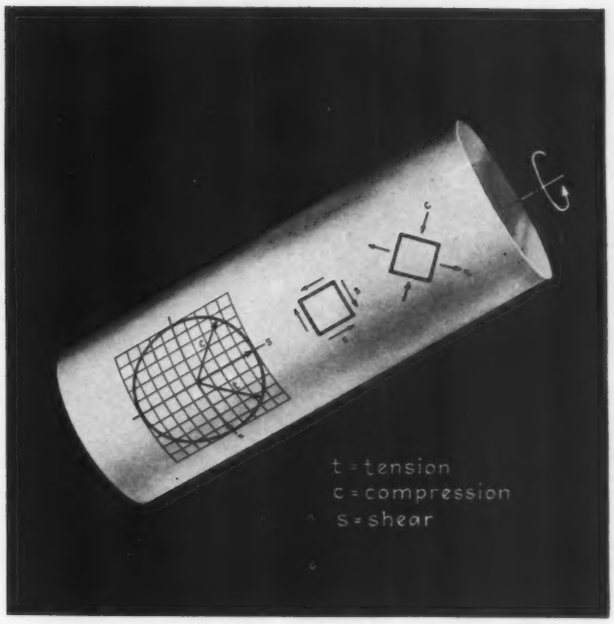


Fig. 13—Stress condition on surface of shaft in torsion. At center and at right are shown shearing and principal stresses acting on two individual elements. The network at the left shows the shearing and principal stresses combined

either alternate bending or tension loads, because when a member is subjected to torsion the shear stress has the same value as the tension and compression stresses as indicated diagrammatically in Fig. 13. This is not true of members loaded in bending or direct tension, for under these conditions the shearing stress is one-half of the tension stress. Because of this equality of stresses under torsion the direction of fracture failure is dependent upon surface conditions and fibre structure of the material in several different planes.

These characteristic differences in stress distribution under torsional loading lead to odd types of fatigue fracture. Under stress conditions as indicated in Fig. 13 a fatigue crack may initiate as a separation fracture in a 45 deg. plane or in a sliding type of fracture in either the longitudinal or transverse plane. Which of these two types of failure develops depends upon whether the tension-compression stresses first reach the separating strength of the material or whether the shearing stresses first reach the shearing strength of the material. Fig. 14 shows an unusual fatigue fracture of the latter type.

As previously mentioned longitudinal defects have little or no influence in bending and tension, however, under torsion a marked reduction in fatigue strength occurs because of the induced stress conditions. Directional properties imposed by rolling mill practice in a bar often are accompanied by a lower shearing strength in the longitudinal than in the transverse plane. Slag lines or inclusions also are particular points of weakness. It is sometimes contended that such points or planes become more pronounced in subsequent hardening processes.

EDITOR'S NOTE: Part III of this article will be presented in the January, 1941, issue. This third installment will deal with some investigations covering the fatigue strength of forgings parallel and across the grain, and the effect of structural conditions on planes of fatigue fracture. Low temperature quenching and surface treatments such as case carburizing, nitriding, induction hardening and flame hardening of local regions, and the metal spraying of surfaces as they influence the fatigue strength of rolled flat chromium-vanadium steel plates, and carbon manganese steel shafts will also be described.

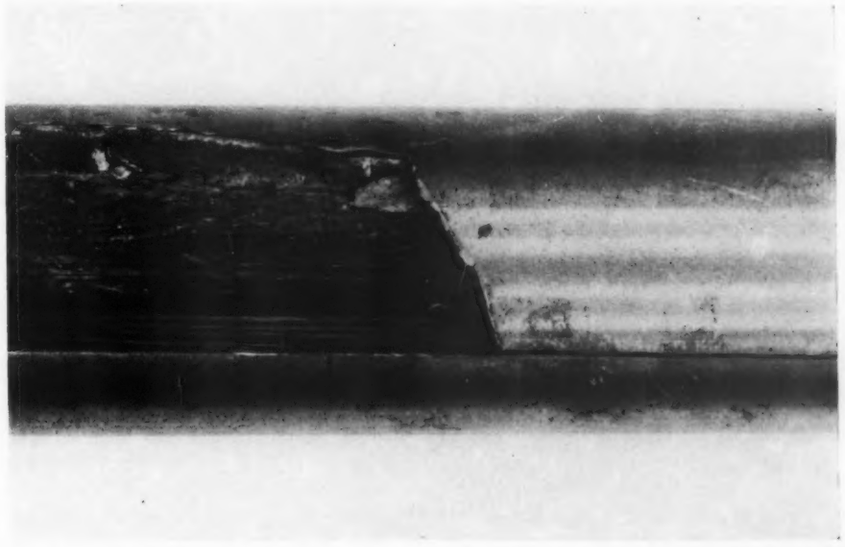


Fig. 14—Shaft with unusual torsional fatigue fracture that failed through shear

Shower nozzles molded in eighteen colors, designed by Mueller Brass Company

COLOR WITH PLASTICS

Applying Acetate-Butyrate to New Product Design

ASIDE from weight and production cost considerations, plastics offer to the designer a practically limitless choice of color. In the acetates alone there are 13,000 colors available and established, ranging from transparent through translucent to opaque and including metallic, pearlescent and variegated effects. Fluorescent colors have recently been added; these plastics take on varying shades in different lights and cost no more than the usual run of cellulose acetates.

Metallic effects are obtained by the addition of a small percentage of aluminum to the mix. Variegated colors are made by manipulating the amounts of different hues, or by varying the hardness of the plastics mixed. If mixed by the molder there is no additional cost; on the other hand they may be obtained already mixed at a cost increase approximating ten cents a pound. Pearlescent colors, although not widely used, cost considerably more as the effect is obtained by introducing, in the manufacturing process, real or synthetic fish scales into the mixture.

If the designer desires to add color to increase sales appeal of his product, he can do so at relatively low cost with injection-molded plastics. Black generally costs the least; plain colors, including the transparent ranges, cost a little more. Of course the stability of any color in a plastic is a direct function of the stability of the die. Generally speaking the lighter colors in delicate shades would have a slight tendency to fade under extreme conditions. Also, when certain definite color matchings must be met, it may be necessary to use a less stable dye. These considerations must all be weighed before the choice of color in the plastic is determined.

Kodachrome illustrations appearing in this article were furnished through the courtesy of the Tennessee Eastman Corporation.

No attempt will be made to set down, or even point out, rules of color choice. Such discussions belong more properly to the field of industrial design. Numerous articles have appeared in P.E. on the subject. (Refer to P.E. *April 1937, pages 129–130; June 1937, pages 231-234; Jan. 1936, pages 25–28*). These articles by recognized authorities point out the particular aesthetic and sales advantages of certain colors and color combinations in products.

When plastic is used, separate cleaning, finishing and drying operations will not be required. Finish is permanent: it runs all the way through and will not mar, chip or fade nor be affected by body acids. Another advantage specifically in butyrate plastic is that the material is tough enough to punch or to have metal crimped around it. Inserts or self-tapping screws can be used; this avoids costly tapping.

In ordering, color may be indicated

by a color sample such as a piece of fabric, paper, paint panel, or the like; or, it may be merely described. Color samples from which selection may be made are usually supplied upon request. In specifying variegated colors in blanks or granulation, the color effect should be described, for example, "cream-brown variegation, cream to predominate, with occasional brown striations."

Where variegated effects are to be produced by injection molding, the granulation should be ordered in plain colors for mixing, as needed, before injection. When the component colors are supplied separately, the molder is in a position to control the variegation by adjusting the relative quantities. Blending is influenced by the size of the piece and by the size of the nozzle, sprue, runners, and gate as well as by molding temperature. It is also influenced by the relative degrees of hardness of the component colors and by their particle size. The predominant base color is usually furnished in a much softer flow, and sometimes in a different particle size, than the other colors, which are known as "fillers." Within limits, some of these factors may be compensated for by changing the proportions of the component colors.

When granulations representing a mechanical mixture of two plain colors are used in compression molding, a mere "salt-and-pepper" effect is produced. A better configuration is obtained when the mixture of colors exists within the granules themselves. Such variegated granulation can be supplied on order from the material manufacturer.

The striated effect on the edge of a variegated sheet differs from that on the top and bottom and is usually more attractive. For this reason, blanks for compression molding are often cut from the molding sheet so that, when placed in the mold cavity, this striated edge becomes the top or appearance surface of the molded piece. To assure the appearance of this edge grain on the desired surface of the piece, the thickness of the sheet from which blanks are to be cut should be given as the last dimension and specified in decimal fractions of an inch.

When transparent or translucent colors are used, the density of the color relative to the section thickness of the molded piece is an important consideration. Color samples show the plastic in four steps of thickness in a single piece, approximately 0.200, 0.150, 0.100, and 0.050 in. If the color of a thin molded part is to match as closely as possible that of a relatively thick one, these samples will assist the designer in determining whether a denser color may be required for the thin part.

If a translucent molded piece is to be placed against dark or light upholstery, wood, or metal, a different color density or even a different color may be necessary. Holding the color samples against the background which will be used will aid in selecting the right color density.

It is generally undesirable to use translucent colors denser than is necessary since it is the depth of color which gives acetate its "life." Often a core or stamping over which Tenite is injected or assembled subsequent to molding is painted a harmonizing shade to preserve the depth of color in the plastic and yet hide the insert.

In the new portable Philco radio, styled along camera lines and carried with a shoulder strap which conceals the aerial, the main objective of the engineers was to obtain color, light weight with strength, and sales appeal. First developed in metal, the design was changed to plastic when it was found that acetate-butyrate had good impact strength and practically unlimited color possibilities. Production costs were reduced by injection-molding and the elimination of finishing operations. With this material, Philco was also able to match a color that they previously had found to have excellent sales appeal.

Basically, the appearance of the radio resembles a portable camera. The case is made in two halves. Since this plastic is dimensionally stable, it was possible to fit the lower half of the housing to the upper half with tongue and groove joints, molded in. A hinge and locking joint is provided at one end by a metal clasp which is crimped over the plastic; projections on the other half of the housing fit into this. The latch at the opposite end was especially developed for this job, and resembles a conventional design of folding camera latch, having a sliding piece, which

locks over two plastic studs integral with the plastic housing. The metal of the latch is riveted through the plastic.

The compact radio circuit assembly is attached to the plastic housing with Parker-Kalon self-tapping hex-head screws. Here again, advantage was taken of the resiliency and strength of butyrate. Knobs are also butyrate, and are molded to a thin strong section. Thin sections on the knob were necessary so that clearance could be provided for the hex-head mounting screws.

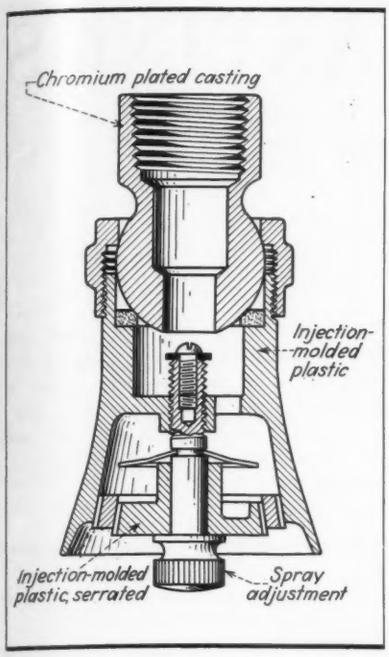
The mottled plastic housing is trimmed with squares of leatherette pyroxilin-coated fabric. These squares come already blanked and coated with adhesive. Not only do they add to the appearance of the finished product but they also serve to conceal any uneven mottles which might appear on the broad flat surfaces. This cuts down the number of rejects and speeds production. The housing is molded in a two-cavity mold in a two minute cycle by the Thermoplastic Division of the Standard Products Company. Completely assembled, the radio weighs 5 lb. 3¾ oz. including the strap aerial.

One of the largest single thermoplastic units ever injection-molded is the housing of the new portable register designed by United Autographic Register Company. The shell is 14 in. long, 7¾ in. wide and 4 in. deep and weighs, including its metal reinforcement, 1 lb. 14½ oz. The housing is molded around a 2 in. wide metal band, drawn and pierced to a high degree of accuracy in a press. The metal band which reinforces the housing is held in place by flow of the plastic through punched holes, which gives a riveted effect. A supporting bridge is spot-welded to the metal band. Plastic ribs, molded into plastic shell crown, are located to give maximum support and strength as determined by dropping tests. The metal band is 0.05 in. steel; the plastic housing is 0.078 in. thick. The housing is molded by Sinko Tool & Manufacturing Company.

Cellulose acetate-butyrate was used for this application because it has good impact strength, and because it is dimensionally stable, important when it is considered that unequal expansion of the plastic and the metal shell is undesirable. As mentioned previously, this stability stems directly from the material's low moisture absorption. With reference to impact strength, the housing has withstood dropping tests from a height of nine feet.

Since this is a thermoplastic acetate material, an unlimited range of colors is always available; thus a change in appearance can be made at any time without any production difficulties. Using acetate material a thin, metal reinforced, injection molding could be produced in a two minute cycle; a heavier compression molding would require a twelve to fifteen minute cycle, and thickness would have to be increased. The housing would be less flexible, the range of colors more limited, and production costs higher.

Previous models and larger models of this register had the shells stamped from metal, then enameled or japanned. The plastic shell is estimated to cost about ten per cent less than the metal shell. Scratched or damaged places are easily buffed out with no effect on the color. Housing is smooth and warm to the touch and has modern appeal.



Eighteen colors, available for customer choice at a minimum of production cost, are obtained in the new Mueller shower nozzle by designing for injection molding the main parts of acetate-butyrate. Thus not only were metal castings and chromium plating processes practically eliminated, but color changes were made feasible without disturbing production schedules unduly. The valve is easily cleaned and will not chip or discolor.

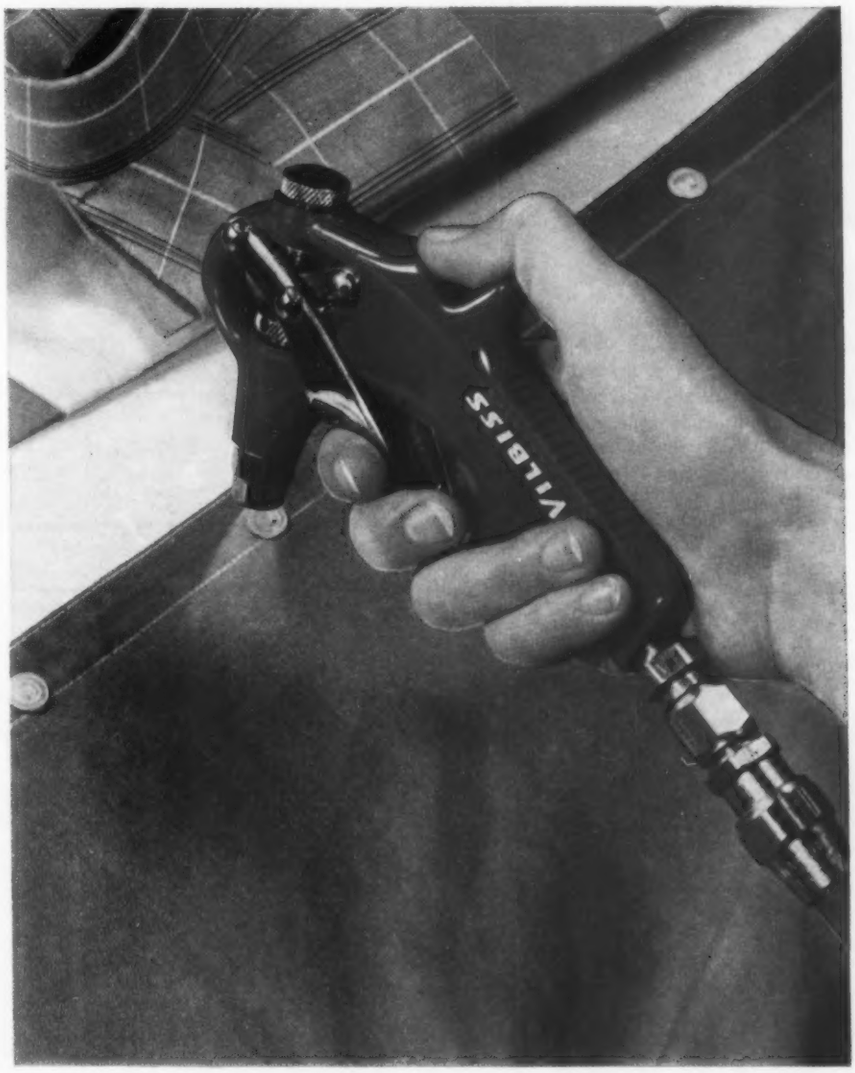
After preliminary studies of the design had been made, and injection molded plastic had been decided on, selection of the type of plastic was based on physical characteristics available. Tenite II had low water absorption, strength to resist impact and to permit threading thus eliminating metal inserts.

This acetate-butyrate plastic has enough inherent toughness to retain its molded shape on tightening of rims and disk. The low shrinkage characteristics of this plastic allowed close tolerances on threads, ring and disk serration, and provided a smooth valve seat which did not require machining. In addition, the hard smooth surface resists abrasion and discoloration from water impurities.

In the new deVilbiss laundry spray gun considerable thought was given to the material to be used. Production quantities eliminated consideration of a sand-casting, weight prevented the use of a solid brass casting for the body. Choice finally narrowed down to an aluminum die-cast or plastic body. The aluminum die casting seemed acceptable for production, weight and appearance, especially since the body could be anodized and colored. A solid plastic body was not used because of lack of strength, thickness of section and water absorption tendencies. The final design is a light zinc die casting forming a strong metal skeleton to carry the water passages and operating mechanism and also providing the necessary backing for a light, plastic cover. To prevent corrosion, the zinc die casting was given a flash of bright nickel plate on the outer surface and the water passages a coat of baked Glyptal varnish. The die cast frame or insert is machined and completely assembled then sent to the molder who applies the plastic body and returns it for final finishing. Bodies are molded, in two halves, dowels on one-half and sockets on the other insure proper mating. The two halves are assembled over the insert and joined by an acetone cement.

The decision between an aluminum die casting and a plastic covered zinc die casting was influenced entirely by costs as it was assumed that either would be satisfactory from the standpoint of appearance and weight. While the die cost for the aluminum die casting was considerably less than the combined costs of the molds for the zinc die casting and the plastic halves of the cover, the lower cost of the plastic assembly more than made up the difference. This difference is mainly the cost of polishing and anodizing the aluminum die casting. The plastic parts come from the mold with the color and lustre of the finished article without further operations. Tenite II was chosen as the plastic because of its color, lustre, flexibility and resistance to breakage by impact.

Although performance, appearance and convenience have been improved over the previous model, the new gun costs less, has been reduced in weight from fifteen to seven ounces and has an attractive modern appearance.



REDESIGNING DIE CASTINGS

To Save Needless Expense

P. F. SCHNEIDER
Chief Engineer, Schultz Die Casting Company

THERE are many general rules for the design of die castings, and the designer is likely to disregard certain of them or to overlook details tending to increase the cost of the die, the casting, or both. The examples shown here clarify certain fundamentals which the designer may well bear in mind—rules are not always apparent when they are stated only as generalizations. Attention to the savings effected in particular cases will help to avoid types of construction which tend to make costs higher than necessary. The changes specified in these examples were suggested to the designers by die casters. All the examples shown in this article refer to actual designs of zinc die castings, but the principles involved can be applied to die castings of any other alloys.

Simplest and least expensive to make the die for this piece is to part it in the vertical plane through the axis of the larger tube. Although a horizontal core slide is required to pull the core from the larger tube, the cores for the tubes at right angles to the larger tube are formed by fixed pins. As originally designed, this casting had a V-shaped bridge cast integrally, as shown in Fig. 1a. This made it necessary to provide two cores and slides at odd angles in order to form the underside of the V-bridge and a third core and slide to form the remaining void above the bridge. By forming the bridge with a central boss for a hole, Fig. 1b, and casting the V-shaped bridge as a separate piece which could be fastened by a single screw through the boss hole, the entire recess within the flared portion was formed by a single straight-draw core.

This example gives point to the general rule: Wherever possible, minimize the number of cores requiring separate slides, and especially those which must be withdrawn at odd angles.

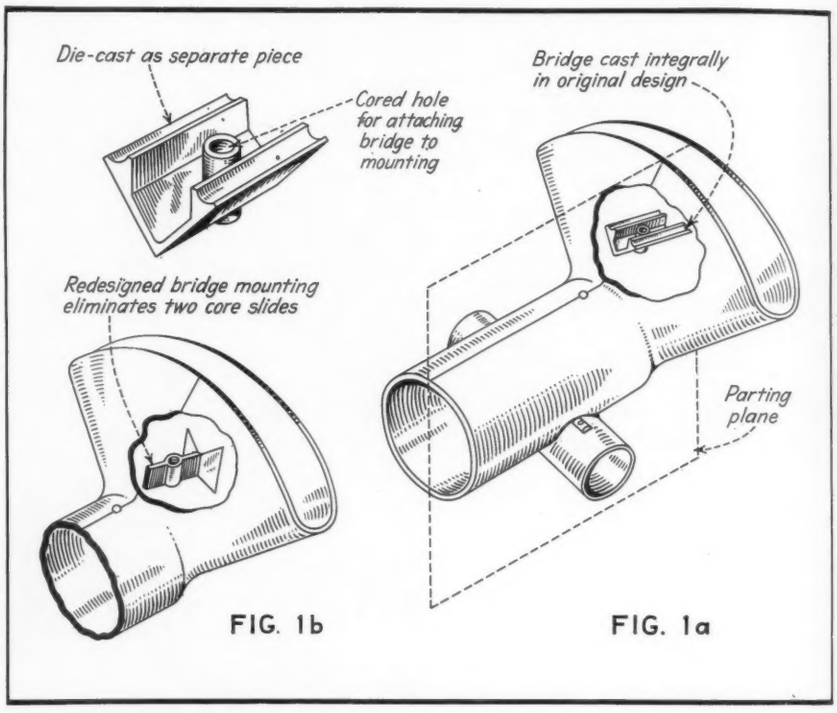

Die-cast as separate piece
Cored hole for attaching bridge to mounting
Bridge cast integrally in original design
Redesigned bridge mounting eliminates two core slides
Parting plane

FIG. 1b FIG. 1a

Handle has two shallow grooves along its U-shaped contour. They are for decoration and probably receive recessed stripes of enamel. Originally the grooves ran off the ends of the piece, where flash occurred, Fig. 2a. Special shaped tools were required to remove this flash and left sharp corners likely to tear the buff used before plating. By stopping the groove $\frac{1}{16}$ in. short of the ends of the piece, Fig. 2b, the ends have rounded contours. This simplifies fin removal as the fin is easily ground off. Unsightly corners also were avoided.

The original design violated the rule: Avoid sharp corners at die partings, especially where flash removal will require special tools and may leave an unsightly jagged edge.

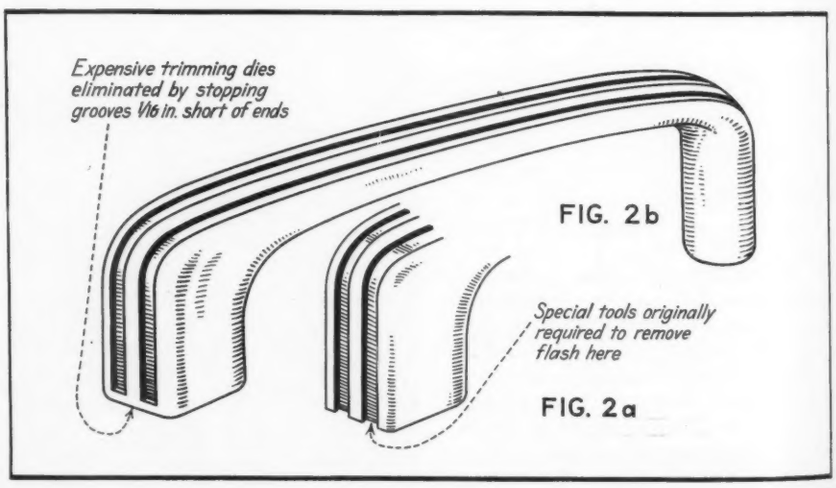

Expensive trimming dies eliminated by stopping grooves 1/16 in. short of ends
Special tools originally required to remove flash here

FIG. 2b

FIG. 2a

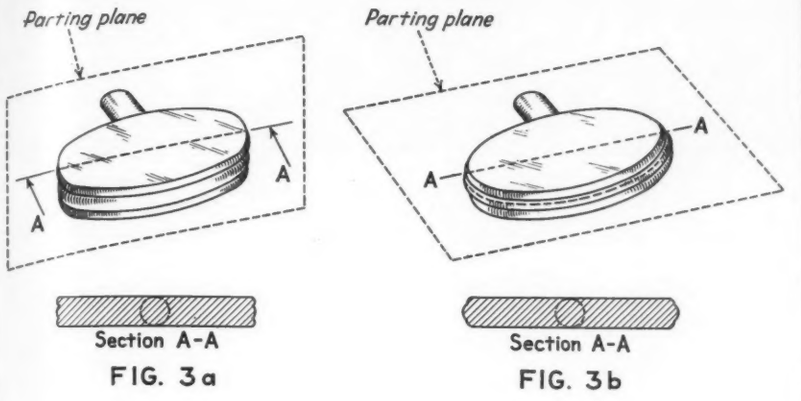


FIG. 3a

FIG. 3b

In this handle, original design called for a pair of grooves around the contour which ended near the rear boss. A casting of this shape would require parting the die as in Fig. 3a, and there would be flash in the grooves and across the flat top and bottom faces where it would be difficult to remove without leaving blemishes. By altering the design, Fig. 3b, it was possible to part the die through the horizontal mid-plane of the piece so that the flash came at a convex contour where it was readily removed either by a shaving die or by polishing. This design saved on die and piece cost.

As a general rule: Design the piece so that die partings will come at convex surfaces, preferably on contours which can be shaved and polished.

Original design of this casting had a groove along each side to fit a rod fastened by a metal clamp, Fig. 4a. To cast the grooves required slides in the die, or parting the casting in the central plane parallel to the rods and making a sliding core to form the central recess. A simpler solution was to remove the undercut by eliminating the lower lip forming one side of the groove and to alter the shape of the stamped strap, as shown in Fig. 4b. This permitted the piece to be cast in a simple die which parted at the face of the casting. The changes in the straps did not change their cost appreciably. The cost of die casting was approximately halved, partly because of savings in flash removal, and the die cost was about one-third as much as a die with slides.

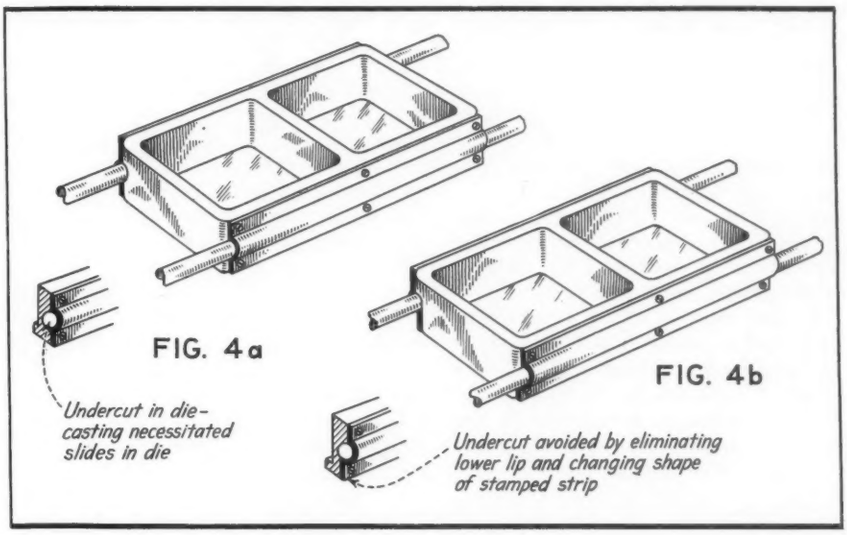

Undercut in die-casting necessitated slides in die
Undercut avoided by eliminating lower lip and changing shape of stamped strip

FIG. 4a

FIG. 4b

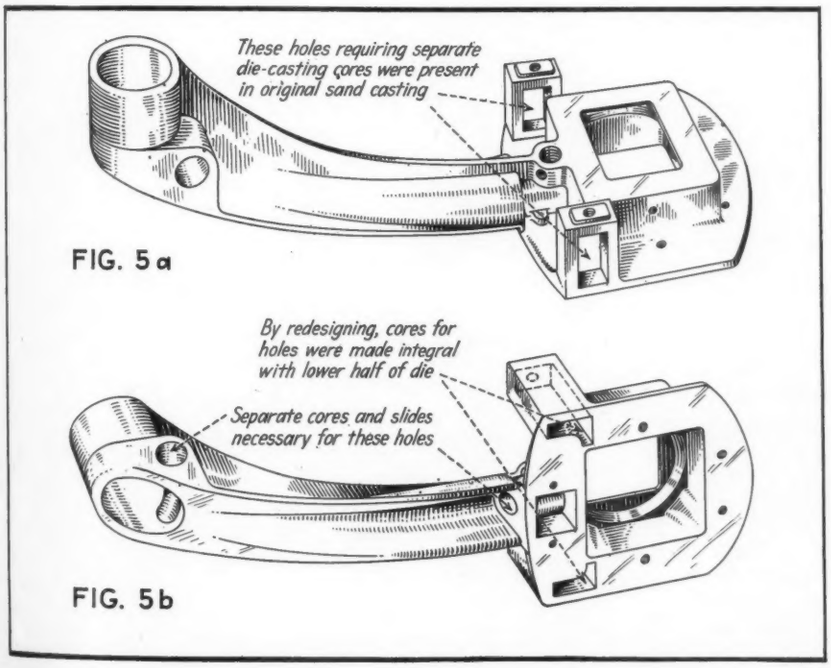

These holes requiring separate die-casting cores were present in original sand casting
By redesigning, cores for holes were made integral with lower half of die
Separate cores and slides necessary for these holes

FIG. 5a

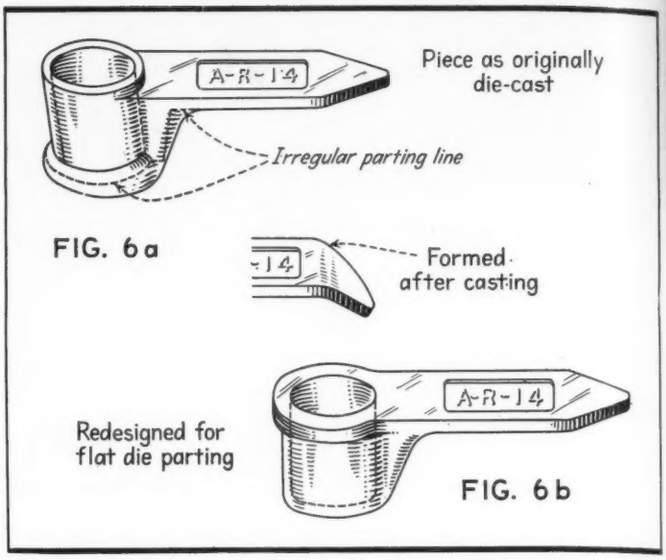
FIG. 5b

In original sand cast sample of this piece the two lugs were cast open at the sides, as shown in Fig. 5a. To do this would have required side cores with slides and would have resulted in flash in the oblong openings. Fig. 5b shows the redesign with the lugs cored out from below. Holes subsequently tapped at the top of the lugs are cored to tapping size, no extra operations for flash removal being required. Although the piece requires an irregular parting line, because of the upward sweep of the extended arm, it is well designed. Section thickness is kept relatively uniform by using cores which, except for the two for the holes noted, are integral with the die blocks.

One of the rules followed in designing these castings may be stated: Wherever possible, form holes and recesses by using integral or fixed cores which are parts of the die blocks, especially where this saves metal and promotes uniform section thickness.

(Continued on next page)

Irregular parting line, indicated by the dotted line, Fig. 6a, is required in the die casting of this piece. After casting and removal of fins the pointer is formed to the curve indicated in the sketch as this simplifies the die and the fin removal tools. If the design were modified to the shape shown in Fig. 6b, with the hole at right angles to the face of the pointer and the flange at the top, a flat die parting could be used and the die cost and flash removal tools would be materially less. It would, of course, still be possible to bend the pointer after casting. Using raised letters also saves money as a raised letter is produced when the letter itself is engraved into the die surface. On the other hand, to cast sunken letters requires raised letters on the die, which cost more. To avoid difficult tooling when the engraving is located in a deep recess of the die it is common practice to do the engraving on the end of a bar or block. This bar or block is then set into the die. This practice can be followed in applying trade marks, numbers, assembly instructions, and even complicated wiring diagrams. Any marking of this kind should be on a surface where the lettering or figures do not constitute an undercut.



Porosity in a die casting is likely to be most pronounced in thick sections. In drilling through such sections, the drill may be broken or the hole thrown out of line if the drill runs into a void. This difficulty was encountered in the carburetor part shown here, Fig. 7a, in which three fairly long holes of small diameter had to be drilled as indicated by dotted lines. Originally the two arms of the casting were made with thick sections in which pores caused drill breakage. By altering the die, Fig. 7b, so that the sections were made only thick enough to give the required wall thickness around the drilled holes, difficulty with porosity was avoided.

The rule to follow in such cases might be stated: Design sections as thin and as nearly uniform in thickness as conditions permit; in particular, avoid thick sections where drilling is required.

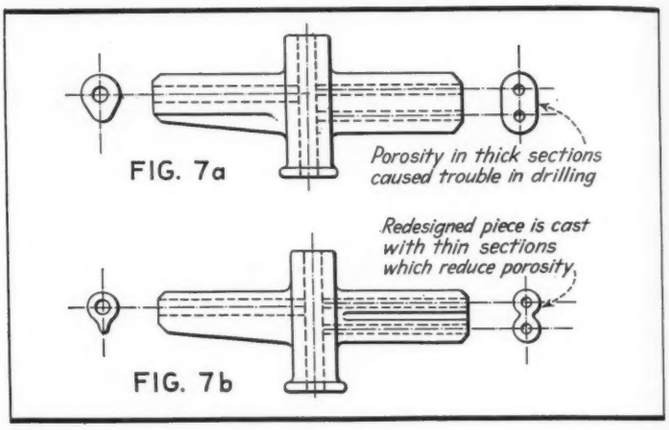
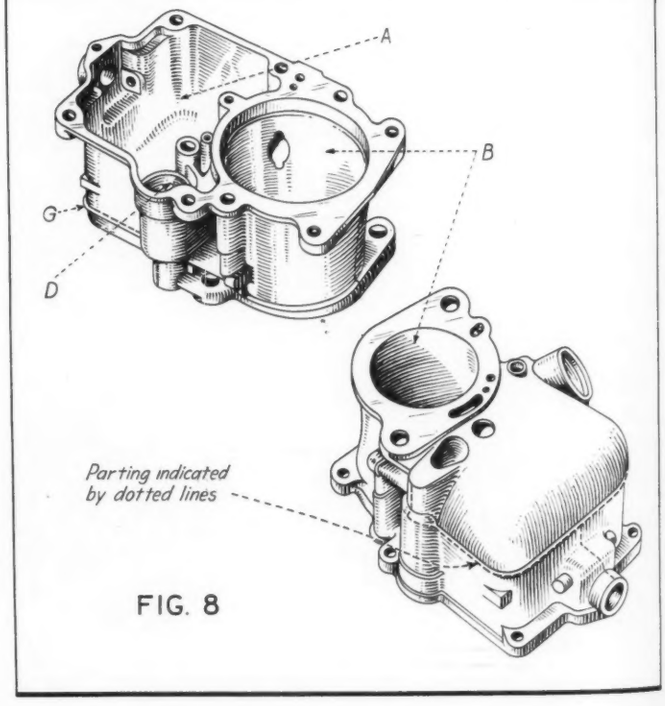


FIG. 7a
Porosity in thick sections caused trouble in drilling
Redesigned piece is cast with thin sections which reduce porosity
FIG. 7b

Undercuts are not always avoidable and may, in fact, result in cost reductions, as in this carburetor body casting, Fig. 8. Produced in large quantities, savings in metal justify an expensive die with slides to form several undercuts on external surfaces to obtain uniformity of section thickness and savings in machine work. The die is parted on the top face of the casting. The front half of the die carries fixed cores which form the major recesses, namely, the bowl *A*, the upper portion of the tube *B*, as well as the recess above it, and the well *D*. Other fixed core pins in this half of the die also form several of the small holes shown in the top view. In the other half of the die are fixed cores which form the passages and other smaller holes. Side walls of the die cavity are formed entirely by the shaped ends of two slides, one of them carrying core pins and both designed to form recesses constituting undercuts. These slides form the exterior surfaces of the tube as well as other faces, some of which are in recesses, thereby saving a great deal of metal, which would be required if the recesses were not formed. There is, of course, considerable flash where cores come together, as indicated by dotted lines. Little of the flash comes in recesses and in some cases a small bead is formed at the partings, as at *G*, which raises the flash above surrounding surfaces. Most of the smaller holes are cored, some to considerable depth, and relatively little drilling or other machining is required to finish the holes.



Question and Comment

"Philosophy of Design" Should Not Convey Impression That All Designs Are Imperfect

E. W. ROBERTS
Cincinnati, Ohio

I wish to enter a protest against an impression created in the article "Philosophy of Design" by C. M. Ashley in your October number.

Whether the author meant it that way or not, it conveys the impression that no machine can be developed without extensive changes from the original designs before it is ready for the market. With such an idea in his mind, the designer is encouraged to carelessness. It reminds me of a remark made by a chief draftsman to a designer who expressed concern as to the practicability of a design he had worked up.

"Don't let that worry you," the chief told him. "That's what we have an experimental department for. Let them do the worrying."

In the course of my 45 years as a designing engineer, I have designed over 100 internal-combustion engines, and some 50 special machines. The latter were chiefly for work formerly done by hand. Every one of these machines and engines went into production without the alteration of a single detail. The reason for such a record is that the development was done on the drafting board.

Don't get the idea that these designs incorporated only tried and tested mechanism. For example: In my first airplane engine, a two-stroke, I used a rotary tubular valve instead of the customary third port to control the admission of the charge to the crankcase. To secure lightness I made the cylinders of solid aluminum castings. These engines, just as they were first designed, went out and flew the awful "crates" of those early days (1911) all over the country. No changes were made until after the first 100 engines had been sent out. Then the changes were minor, such as making the cylinders of an iron shell with an aluminum jacket shrunk on.

On my first automobile, designed some forty years ago, I designed every item except the wheels and the axles. These included the engine, the transmission, the steering column gear, the frame and the body. I made but one change. The throttle and the spark levers at the base of the steering column interfered, and I had but to bend them to get proper clearance.

My purpose in writing this account is to show that a machine or a device can be developed to completion in the drafting room. In commercial designing this is just what the client expects. If the machine does not work as expected, they consider the designer does not know his business.

Blind Riveting Method

To the Editor:

The accompanying sketches show a method of blind riveting suitable for rivets ½ in. in diam. or less. Although this method is not new, it is not well-known and may be of interest to the readers of PRODUCT ENGINEERING.

The method can be used for riveting a plate or other part to a casting or forging and obviates the necessity for tapping. It can also be used as a simple method for plugging holes.

The sketches show the rivet and the stages of the riveting operation. The ball used with the rivet is a standard hardened steel ball and its function is simply that of an expander. This suggests that if a ball is not available some other expander such as a steel wedge might be substituted.

The hole for the rivet should be drilled for a fairly easy drive fit. Diameter of the ball should be three-quarters the diameter of the rivet. All essential dimensions are given on the sketch.

—JAMES O. G. GIBBONS
Bloomfield, N. J.

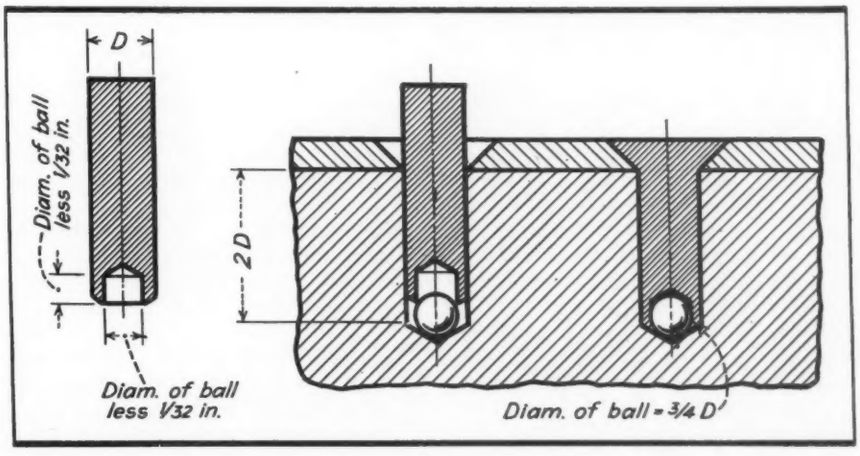
Modifies Statements On Aluminum Spot Welding

To the Editor:

There are a few statements set forth in the article, "Spot Welded Aluminum Aircraft Structures," (PRODUCT ENGINEERING, September, 1940, p. 388–392) which do not agree with actual practice at this plant.

For example, the statement on page 390 that the "welding pressure varies directly and proportionally as the thickness of sheet which is contacted with upper electrode" is not borne out by our experience. The ratio of tip load to sheet thickness becomes smaller the heavier the sheets, and where unequal thicknesses are welded the tip load is a compromise between the tip loads for the individual sheet thicknesses, favoring the thinner gage.

A further assertion, also page 390, that unequal sheet ratio should not exceed 3 to 1, may be modified in the light of our experience. The ratio may be increased considerably as long as the welder is capable of concentrating current through the thinner sheet. For



example, 0.032 and 0.187 gage 24ST Alclad sheets were quite easily welded when the sharp electrode was placed on the 0.032 sheets. This relation would have produced no weld even with double the power if the tips were reversed.

The statement that spot diameter is a direct indication of spot strength is correct only when qualified as referring to a given spot quality. The metallurgical properties of the spot itself and, to a greater extent, the degree of annealing of the surrounding parent metal are the real criteria of spot strength as demonstrated in practice.

—P. H. MERRIMAN
Glenn L. Martin Company

Put Nameplates So They Will Be Seen in Photos

To the Editor:

Name plates have more sales value if placed on the machine not according to design logic but according to photographic possibilities. Often enough a name plate is set where it harmonizes best with other parts of the machine, giving it a drawing board attractiveness. But the headstock cover of a lathe, for example, is not the best place for the name plate. The tool carriage is a better location because it features in more photographs, since publication photographs are generally cropped to include only point of interest. —ALLEN FISKE
Chicago, Ill.

"How Deep The Pond"

To the Editor:

In the September, 1940 number of PRODUCT ENGINEERING, page 422, there appeared a mathematical problem by H. E. Smith, entitled "How Deep the Pond?" The solution to this problem, as worded here, is, I believe, 17.5 ft.

The problem is again stated in the November number, reworded to the point where its original meaning becomes obsolete in terms of the answer of 17 ft., which satisfies a condition quite unlike that originally suggested by the problem as it appeared in your September number. Both problems, apparently intended as one and the same, describe in reality two very different situations and naturally each has its own particular solution. —HAROLD S. LOVELESS
Pitney-Bowes Postage Meter Company

[*Editor's Note*—Right, Mr. Loveless! The phrase "on the surface," referring to initial position of the blossom, should have been left out of the original statement of the problem. Correct answer then is 17 ft. deep.]

Submits Solution To Rope Tension Problem

To the Editor:

In PRODUCT ENGINEERING for June, page 276, Mr. S. H. Welland presented a problem where a cord is wrapped four times around two parallel shafts. The cord supports a load of 10 lb., and Mr. Welland wants to know the tension in each succeeding wrap and the force necessary at the slack end to balance the 10-lb. load. Coefficient of friction, μ, is 0.20. Fig. 1 is a restatement of this problem. This is a problem which does not deteriorate with age, so I am submitting this solution.

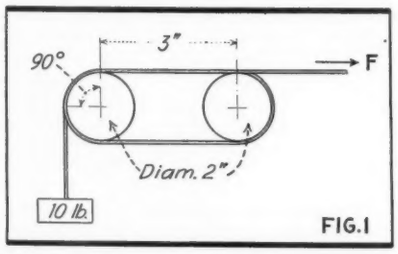


FIG. 1

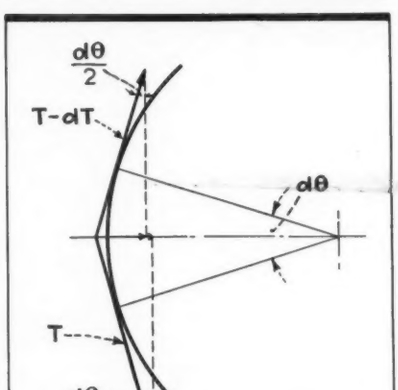


FIG. 2

Fig. 2 is an enlarged view of the condition existing in the cord as it passes around one of the shafts. Let there be a decrease in tension of dT in the arc included by the angle $d\theta$. It can be seen that the normal force on the rod is expressed as follows:

$$n = \left(\sin\frac{d\theta}{2}\right) T + \left(\sin\frac{d\theta}{2}\right)(T - dT)$$

but since $d\theta$ is small,

$$\sin\frac{d\theta}{2} = \frac{d\theta}{2}$$

and

$$n = T\frac{d\theta}{2} + T\frac{d\theta}{2} - dT\frac{d\theta}{2}$$

The term in the brackets is of a higher order and thus can be dropped, giving

$$n = T\,d\theta$$

and the force of friction is $\mu\ T\ d\theta$.

Therefore $dT = -\mu\ T\ d\theta$

$$\int_{T_1}^{T_2}\frac{dT}{T} = \int_0^{\theta} -\mu\, d\,\theta = \log\frac{T_2}{T_1} = -\mu\theta$$

where

$$T_2 = T_1\, e^{-\mu\theta} = \frac{T_1}{e^{\mu\theta}}$$

$\mu = 0.20$

θ = angle in radians

The above is the familiar formula for the tensions in the tight and slack sides of a belt. By applying these formulas the required number of times, the tensions in each succeeding wrap are found to be: 10 lb., 7.31 lb., 3.91 lb., 2.08 lb., 1.116 lb., 0.596 lb., 0.318 lb., 0.170 lb., 0.091 lb., and 0.048 lb. The force then necessary to balance the 10-lb. weight is 0.048 lb. —EVAN W. EVANS
Los Angeles, Calif.

Can You Work This One?

H. E. SMITH

This month's problem—

Quickest Way Home

An engineer is fishing from a rowboat anchored five miles out from a straight stretch of shore. If he should row directly in to shore, he would then be 20 miles from his summer cottage in a small fishing village. He can average three miles per hour by rowing his boat, and can walk five miles per hour. Like most engineers he is very efficient, so he figures out a way to get home in the shortest possible time by rowing at a diagonal to the shore and walking the remainder of the way. In so doing, how far does he row, how far does he walk, and how long does it take him to arrive at his cottage?

Solution to November problem—

Author! Author!

In last month's problem six authors were seated in a railway compartment. We were told their names and what they wrote, not respectively, and that each was reading a book by one of the others. From the facts given, we were asked to classify each of the authors and tell what he was reading. If we did it right, we found that:

Mr. White is an essayist, reading history. Mr. Brown is a poet, reading a novel. Mr. Green is an humorist, reading a play. Mr. McGillicuddy is an historian, reading humor. Mr. Gray is a playwright, reading poetry. Mr. Black is a novelist, reading essays.

News and Summaries

Engineering Training for National Defense Now Getting Under Way in Colleges

Government's $9,000,000 grant offers opportunities to technical men who wish to prepare for greater responsibilities in defense jobs

UNDER THE IMPETUS of the National Defense Commission and the United States Commissioner of Education, plans are now being completed and in some cases have already gone into effect for the widespread training of technical men in special college day or evening courses designed to up-grade and prepare them for specific defense needs. Although these plans have not yet completely crystallized, they are now definite enough to serve as a guide for interested industrial concerns or engineers.

Courses, offered tuition-free under the recent $9,000,000 grant of the government, will be of two types for men with some technical training or practice: full-time courses requiring about 40 hours per week and lasting for a few months, and evening courses requiring about 15 hours a week. These courses not only can prepare a man for a defense job in a field outside of his present work, but also can prepare him for higher responsibilities which the defense program may impose upon him in his present job. These courses will be offered by selected engineering schools throughout the country.

Courses will specifically approach engineering problems relating to the defense program. The National Defense Commission, the Office of Education, and the engineering schools participating in the program are cooperating with local industries to determine just what courses of study are needed most. Washington sources reported that first suggestions offered by colleges had to be revised because the courses outlined were too academic and were not aimed directly at the defense training problem. Programs such as those used by Glenn L. Martin and Lockheed, where training is given for definite jobs rather than for sketchy and general teaching, may lead to further improvements in the plan and may result in a plan where employees are given special courses in the plant and on the job.

Greatest need at the moment is training to provide men for:

Inspection of materials, chemicals and explosives, instruments, and power units, especially for ordnance and aircraft.

Design of machinery and equipment, tools and dies, and aircraft power plants, structures and instruments.

Production engineering and supervision.

Physical metallurgy.

Marine engineering and naval architecture.

Up to now very little is known as to how many men will be needed and for what jobs they will be required. In fact, except for requests for several thousand inspectors in chemical and armament plants, no needs have been definitely determined. Some engineering schools have organized committees to contact local defense industries in order to determine the requirements and provide a sound basis for outlining study.

The country has been divided into twenty districts, for each of which a district adviser has been appointed. The district advisers, capable men acceptable to labor, industry and local committees, work under the direction of J. W. Studebaker, Commissioner of the U. S. Office of Education, in close cooperation with the engineering schools and the defense industries in their localities.

Persons interested in the program are advised to contact the nearest accredited engineering college, the engineering school from which they received their degrees, or the Engineering Defense Training Division, U. S. Office of Education, Washington, D. C. Men accepted for the training will be selected from the applicants by the colleges, or will be chosen by their employers for specific study. It is expected that some colleges may contact former students to fill requirements.

A person finishing a prescribed course will immediately qualify for Civil Service examinations in the field for which he studies. Whether or not he receives credit toward a degree depends upon the individual school. As to whether the standing of a person under the Selective Service program will be affected by these courses, this is a matter for the local draft board to decide.

Although many of the courses outlined in this article are open to high school students, they are principally designed to increase the technical abilities of men with the equivalent of three or more years of engineering education. An additional $43,000,000 has been appropriated by the government for the training of skilled labor to fill the thousands of jobs now going begging in defense industries.

A complete index for 1940 follows page 586 of this December number. Keep it in mind for occasions when you want to look up something you've seen somewhere in PRODUCT ENGINEERING.

New Alloy Discovered For High Temperatures

HIGHER operating temperatures and increased efficiency for steam turbines may be made possible by a new iron alloy containing small amounts of columbium, a previously unimportant metal, announced E. R. Parker of General Electric Research Laboratories, at the annual meeting of the American Society for Metals. Tensile, creep, and rupture tests indicate that an alloy of iron containing 3 per cent of columbium is superior to expensive steels now used at high temperatures and high stresses.

Special steels are now available for turbines operating at today's highest temperatures—about 1,000 deg. F. At temperatures of 1,100 deg. F. and above the strongest metals are not the carbide steels so successfully employed up to this temperature, but rather are alloys containing a finely dispersed stable phase, such as the iron-columbium compound in the columbium alloy. Steel alloys with high molybdenum, tungsten, vanadium content would be very expensive at the higher temperatures.

Columbium-iron alloys have been pro-

duced in the laboratory by mixing correct proportions of powdered metal, sintering them, and swaging the fused mass into a metal capable of being heat-treated and machined. The alloy has also been cast and forged with equal success. Considering cost, ease of production, machineability and other properties, columbium-iron alloy has been found to be far superior to other known high-temperature alloys.

N.Y.U. Announces Course In Research Management

RAPID DEVELOPMENT of industrial research, combined with its growing importance in the national defense program, has led to the opening of the first course in the country in research laboratory management, it was recently announced by New York University College of Engineering. This course, perhaps the forerunner of similar courses throughout the country, will consist of sixteen evening lectures given by members of the college faculty, executives from industry, and the National Research Council.

"It is estimated that there has been a 100 per cent increase in the number of research laboratories established since 1927, with relative increases in personnel and expenditures," Dean Thorndike Saville said. "These facts have caused problems of management, administration and accounting in a branch of industry which heretofore has been comparatively simple in administrative organization."

Outline of the course has been planned in cooperation with an advisory committee of industrial research executives, headed by Maurice Holland, director of the Division of Engineering and Industrial Research of the National Research Council, who suggested the course.

Leather Belting Standards Recently Drawn Up

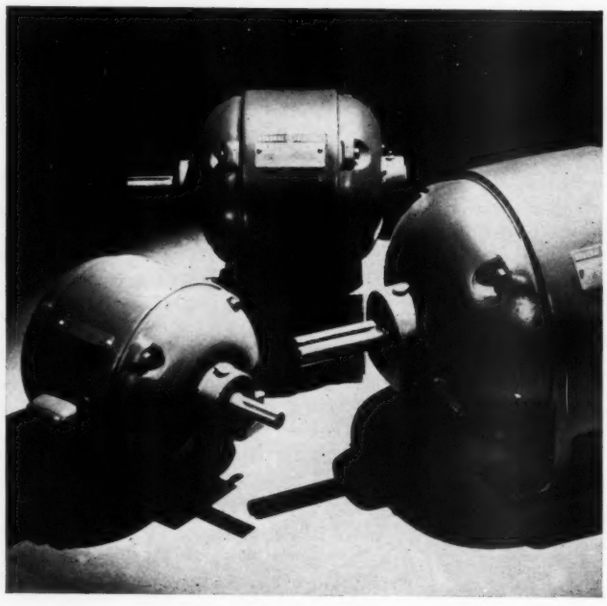
DRAFTS of the proposed "American Standard for Specifications and Horsepower Ratings of Vegetable-Tanned Flat Leather Belting" have recently been completed and are now being distributed for criticism and comment to all industries concerned with leather belting. These standards, set up by a committee organized under the procedure of the American Standards Association with the American Society of Mechanical Engineers as sponsor and the engineering committee of the American Leather Belting Association as collaborator, are expected to be of much help in the reconditioning of old machinery and the installation of new machinery using leather belts during the retooling period of the national defense program.

Do You Know That—

ENGINEERING AND DEVELOPMENT accounted for 10 per cent of the gross 1939 income of one aircraft manufacturer. Considering the money spent on research by engine and accessory manufacturers, this percentage must necessarily be much higher. (33)

OIL CUPS FOR MACHINES have been molded from canvas impregnated with a synthetic rubber solution. (34)

IF SOYBEAN OILMEAL cost only $15 per ton, present processes would make it feasible to produce bulk plastics at a price below wood. (35)



A 12-year step forward was taken by motor manufacturers last month when the first motors built under the revised N.E.M.A. frame dimension standards were checked off the assembly line. N.E.M.A.'s official blessing on improvements made in silicon steels and insulations made possible the first major changes in small motor construction since the original standards went into effect 12 years ago. Two leading manufacturers are making the most of the occasion by incorporating many other improvements and introducing motors whose sleek appearance is in sharp contrast to previous sway-backed models.

General Electric's completely new Tri-Clad polyphase induction motors (left) feature increased protection by a cast-iron frame, Formex wire, Glyptal-coated windings, improved dust-tight bearings and lubrication, and redesigned air deflectors and fans for double-end cooling. Rotor is of cast aluminum. All openings in end shields and frame are below the centerline.

Westinghouse simultaneously announced new compact a.c. polyphase, single phase and d.c. motors, first of which is shown at the right in comparison with an older model of similar rating and electrical characteristics. Frames from ½ to 3 hp. have been redesigned for lightness, compactness, and better appearance, and a new bracing structure gives them more strength. Bearing housings have improved dust seals.

ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

"Emergency" engineering will bring out many developments that will be useful in post-war peace time. Among them: reduced price of aluminum; prefabricated housing; mass production of airplanes which may bring the price within reach of average means; many new uses for plastics; higher octane gasoline for automobiles; production of synthetic rubber; establishment of a tin-smelting industry; greater use of magnesium which will release more aluminum for more uses; increased production of ammonia for fertilizer; revitaminization food, replacing vitamins which are lost in processing; reduced price of high alloy steels.

Bomb-sight fables have gone the rounds but here is the approximate truth. "The" bomb-sight is a myth. The Army has one, the Navy has a different one, and there are variations in designs of both. News reports that the Government has released an "outmoded" model of "the" bombsight, are, therefore, untrue. What the British got was the Army's latest sight which is manufactured by Sperry Gyroscope Company. It is more accurate than any other sight but it is not fabulously better, as gossip says. Sperry will make some of the sights for Britain, but probably will have most of them made by other firms in precision lines. The British may build some of their own. Incidentally, the Germans have four different bomb-sights. The British have taken them all from planes brought down intact. You can assume, also, that the United States Army has them. 'Tis said that Sperry sights used by the British will be equipped with little bombs which would destroy them at the will of the pilot or when the ship crashed.

"Pointed boxes" is how the British dubbed a hurry-up ship design which they proposed to build in a shipyard which they would finance in this country. As this was written, the British ship mission had not come to a decision with our Government. If they build the plant, it will have 28 ways. The ships would be designed to conserve skilled labor, and for speed of construction. They would be little more complicated than powered barges. Parts would be fabricated with broad tolerances in all manner of American factories and sent to the yard for assembly. Common labor with wrenches and rivet hammers and a skilled man with a blueprint would do most of the work. All kinds of power plants, anything that would churn up a few knots, could be used.

Plans for houses may be drawn by industrial designers rather than architects in the next few years if the men in charge of the defense housing program get their way. It looks as if houses prefabricated in factories would get their first real test on a mass production scale. What makes prefabrication attractive right now is the fact that houses bolted up from panels can just as easily be unbolted and moved somewhere else when the emergency is over. Housing coordinator Palmer would like to build as much as $150,000,000 worth of prefabricated houses. Trouble is, there are not at present any manufacturers able to supply house elements in real quantity.

Spook stuff, now and then, is relished by the most technical men. Aircraft flying at high altitudes over England are making white sky trails. These are not only attested to by competent observers, but are shown in photographs. There are two phenomena: the wing-tip trail, and another coinciding with the slipstream, which is therefore helical in shape. Observation tends to prove that the sky trails are not formed by exhaust gas; at times long breaks occur. If we find out the answer we'll let you know.

Some good airplanes may be pretty completely re-designed as a result of the new plan to have auto firms build parts and sub-assemblies for aircraft. The Defense Commission is trying to make up its mind whether to concentrate on immediate production, in which case the Detroiters would simply copy plane factory methods, or to work towards a maximum ultimate capacity. In the latter case, the airplanes to be built would be revamped to adapt them to auto plant methods. Widespread substitution of welding for riveting is one change talked of. Another is to use stainless steel instead of aluminum sheet. This would avoid a possible shortage of aluminum, would be closer to metals the auto builders are familiar with, and would eliminate the elaborate heat treating that aluminum requires.

Navy architects and strategists of all seapowers are reflecting seriously on damage done by RAF to three Italian battleships at Taranto. It is generally agreed the attack was made with aerial torpedoes, which are slung underneath the plane, aimed and dropped from a few feet above the water. Wrecking of a $100,000,000 weapon with one costing about $100,000 or less is something for war experts to think about. Britain, depending heavily on sea power, is now in an odd position, having demonstrated the battleship's vulnerability.

Copper-skin bullets are reported in use by the Germans for piercing armor of tanks and aircraft. The idea is that upon impact the copper mushrooms against the armor in a fused condition and sticks there while the steel heart of the projectile gets a bite without ricocheting. Ordnance men of the U. S. Army tell PRODUCT ENGINEERING that this is a perfectly sound idea, but that it is not enough different from common practice to attract much attention. All armor-piercing bullets are soft-skinned to accommodate the rifling of the gun, and mushrooming does aid penetration by "sticking." The fusing characteristics of one skin metal as compared with others is debatable.

Highway Lobbyists here who have been urging more road money with the argument that highway design is far behind the potentialities of automobiles are a little red-faced over reports from the new Pennsylvania Turnpike that the cars won't stand the sustained high speeds permitted by the 160-mile express road. Experiments conducted deliberately by automobile firms and involuntarily by road-scorching tourists show that most cars will burn out if driven at 90 for an hour and that a sustained 100 m.p.h. will burn up any of them. Tires likewise won't stand the speed, and there have been several serious blow-out accidents.

New Materials and Parts

Engine Synchronizer

Basically, the "Synchro-Master" is a mechanical governor connected to two internal combustion engines by tachometer cables, and also connected to the carburetor of one of the engines, which is designated as the "following" engine. The lead engine is carburetor controlled in the usual manner. The Synchro-Master, by opening or closing the carburetor of the following engine,

automatically brings it up to the same speed as the lead engine. The operation is entirely mechanical in principle. Means are provided for automatic throwout in case of failure of either one of the engines to which it is attached. Synchro-Master, Seneca Falls, N. Y.

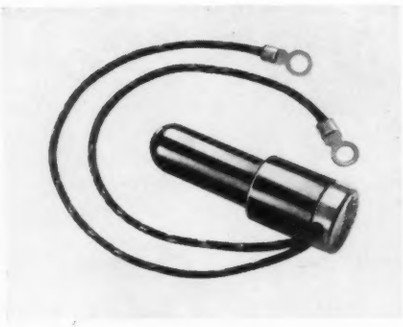
Interval Timer

The timer is driven by a self-starting synchronous motor and is inclosed in a dust-tight, splash-proof, cast aluminum housing with full vision window and external setting knob. Full view bull's eye light signals can be supplied. Distinctive features of this Model D2 timer include: 12 different scales ranging from one revolution in 15 sec. to one revolution in 24 hr.; dials are 3 in. in dia. with large white etched characters against a black enameled background; non-clouding window made of unbreakable material and recessed and gasketed to provide a splash-proof inclosure; a spring and gasket construction around

the control shaft to prevent entrance of moisture; and a cast aluminum housing with a black plastic cover sealed by a rubber gasket. The R. W. Cramer Co., Inc., Centerbrook, Conn.

Mercury Switches

Designated as No. A-5M and No. A-10Z, these two new mercury switches are capable of carrying substantially greater current than the regular Durakool switches of the same physical dimensions. The A-5 mercury switch is



rated for 200 watts a.c. lamp load for on and off operation not exceeding 20 times per minute. The new design A-5M, although of the same physical dimensions, has successfully withstood 750,000 operations on a 500-watt a.c. lamp load at an operating speed of 5 times per minute. The A-10Z has a correspondingly greater capacity than the standard A-10 mercury switch of the same physical dimensions. The A-5M switch requires only a small angular tilt for operation, even under heavy load, and it is especially adapted to snap acting mechanisms, as well as tilt action. Priced only slightly higher than the standard 5-amp. switch, it can be used in a great many applications which formerly required the A-10 (10-ampere switch). Similarly, the A-10Z can be used in many applications where formerly the capacity of the A-10 was insufficient and the much larger physical dimensioned A-20 switch was required. Durakool, Inc., Elkhart, Ind.

Renewable Cartridge Fuse

Because of the absence of metal and ferrules, it is possible to insert and remove the new Solar fuses without the use of fuse pullers. A tough casing of hard fibre completely eliminates the possiblity of shock when removing the fuses. The fuse has only two main parts besides the renewable link. Approved by the Underwriters Laboratories. Warren Lamp Co., Warren, Pa.

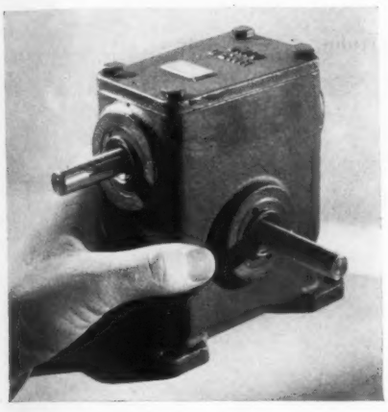
Sealed Ball Bearings

Available in fractional inch bores for shaft diameters ranging from $\frac{5}{8}$ to $2\frac{3}{16}$ in., these bearings are permanently sealed, pre-lubricated, fitted with location snap ring to permit through bore in housing, have an extended inner ring, and can be securely locked on the shaft with either knurled cup point setscrews or one-half dog point set screws with lock wire. With the patented Sealmaster centrifugal labyrinth seal no seal is

required in the housing. Annular grease groove with two holes in the outer diameter of the outer race permits regreasing, although the pre-lubrication and ability of bearing to retain lubricant reduces maintenance to a minimum. The bearing is fitted with a snap ring as standard equipment and there is no need of counterboring the bearing housing in order to provide a shoulder for locating the bearing. Knurled, cup point setscrews are furnished as standard equipment. One-half dog point setscrews with lock wire can be furnished on request at no extra charge. Stephens-Adamson Mfg. Co., Aurora, Ill.

Small Speed Reducer

Designated as B H U, this small speed reducer measures 5⅜x3 in., with a height of 5⅝ in., making it specially adaptable for use with fractional horsepower motors. It is offered in three assemblies: with output shaft projecting to the right, to the left, or projecting in both directions. Six stock ratios are available, ranging in speed ratios from 10:1 to 48:1. A bronze worm-wheel and a hardened ground worm are mounted in Timken roller bearings. Torque capacity of speed reducer is 150 in.-lb. The Ohio Gear Co., 1325 E. 179th St., Cleveland, Ohio.



Plastic Packing

Super-Seal plastic packing, a dry graphitized plastic packing made from asbestos, anti-frictional metal particules and special binders, is now being made with a patented tape back reinforcement, securely vulcanized to the outer surface of the packing. This vulcanized tape reinforcement replaces the old frictional woven cotton jacket and thus provides a non-frictional surface bearing directly against the moving part. The tape back reinforcement makes the new packing extremely pliable so that it can be bent around small diameter rods and shafts without fracturing or cracking, or formed into small inside diameter rings without distortion. The packing contains no oils that can be driven off by heat or pressure, and flows readily under gland adjustment. It is recommended for centrifugal and rotary services such as centrifugal pumps, low-pressure steam rods, valve stems, expansion joints and similar applications. Available in six styles or type, each type in sizes from ¼ in. to 1 in. graduated by sixteenths, in coil, standard length spirals, in die-formed rings or in sets to stuffing-box dimensions. Crane Packing Co., 1800 Cuyler Ave., Chicago, Ill.

Motor Starter

Designed for across-the-line starting of single and polyphase squirrel cage induction motors, and for primary control for wound rotor induction motors, this new automatic motor starter allows automatic control, local or remote control, or control from two or more locations. Provides low-voltage release and no-voltage protection, as well as protection against damaging over-loads to motors. Three-point ball bearing suspension of the movable electro-magnet assures a floating action that minimizes friction and guides contacts smoothly into correct alignment. Magnet operates vertically and cannot close accidentally by shock or vibration. Other features include the double break rounded silver-to-silver contacts; layer wound magnet coils with paper section construction, fully taped, impregnated and baked; the "E" shaped magnet designed to give a strong pull with low power consumption; easily removed contacts and magnet coils; ample wiring space and plenty of knockouts. May be furnished for remote control, local control or with transfer switch and cover. Supplied in general purpose sheet steel cabinets, in water-tight, weatherproof cast aluminum inclosures or as interior only for special applications. Colt's Patent Fire Arms Mfg. Co., Electrical Div., Hartford, Conn.

Molded Metal Products

Self-lubricating bearings and other powdered metal products are now available from a new company recently formed for this specialized manufacture. Plant equipment is of special design, based upon the most recent developments in powdered metallurgy, so that parts can now be produced which heretofore have been impossible. A complete research and experimental laboratory is maintained for development and tests of any particular powdered metal parts. A complete variety of self-lubricating bearings are now available. National Molded Products, Inc., 122 Mill Street, Saint Marys, Pa.

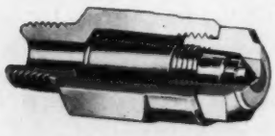
Marked Shim Stock

Thin shim stock in rolls is now supplied in slotted cartons with the lengths plainly marked in inches along the edge of the shim. Thus the precision-

thin metal can be conveniently pulled through the carton slot and cut off to the exact length required. This not only avoids waste but also indicates when the roll is almost exhausted. These handy packaged rolls of brass or steel shim stock are available in widths of 6 in. and in shim thicknesses ranging from 0.001 to 0.015 in. Laminated Shim Co., Inc., Glenbrook, Conn.

Atomizing Nozzles

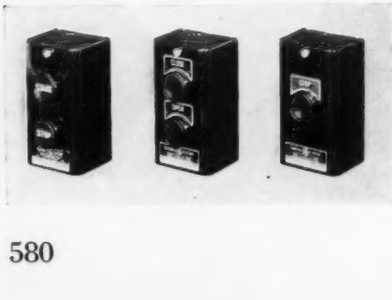
To be used for spraying water, oil, or other liquids with similar viscosity, these new nozzles are of sturdy construction, accurately machined with polished orifice insert. Spray pattern is



hollow cone with uniform distribution and maximum atomization even with relatively low hydraulic pressure alone. Capacities range from 1.2 to 17 gal. per hr. at 60 lb. per sq.in. Standard stock construction is brass with 18-8 stainless steel inserts for orifice and core tip, and Monel built-in metal strainer. Also available in stainless steel throughout. Made for male and female ¼ in. pipe connection. Spraying Systems Co., 4011-21 W. Lake St., Chicago, Ill.

Pushbutton Stations

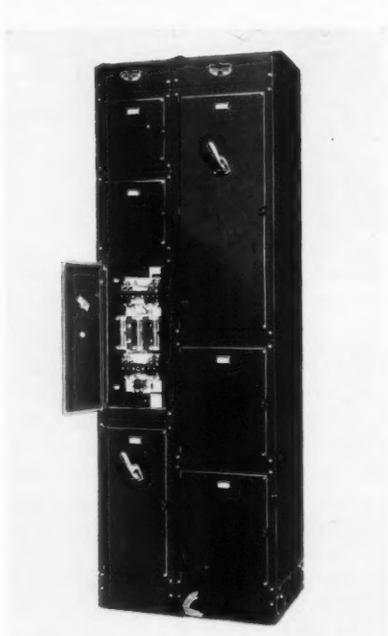
These general purpose one- and two-button standard duty pushbutton stations offer improvements in operation, appearance, and ease of installation. Molded buttons made slightly concave for convenience are protected from accidental operation by guard rings. The words "Start" and "Stop" molded into the front of the buttons are filled with white paint to make them easily readable. Stations are 4 9/16 in. high, 2⅝ in. wide, and 2½ in. deep, with ample wiring space. Inclosure is made entirely of steel and consists of back



and cover. Cover is crimped over at the ends to over-lap the top and bottom ends of the back, and is held in place by one screw at the top and one at the bottom. Contacts are of fine silver backed by steel. As the contacts close, a rolling action produced by an off-center contact bar causes the contacts to roll slightly. This assures a good contact and tends to prevent welding. A pressure of 38 oz. is required to depress the "Start" button, which higher pressure reduces the possibility of contacts welding. General Electric Co., Schenectady, N. Y.

Sectionalized Motor Control

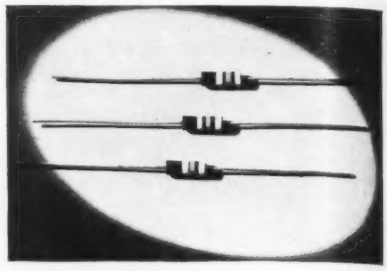
Unitrol permits all needed types of control devices to be organized in locker-like motor control centers instead of the usual "pillar and post" method of mounting. Standard motor control



units are mounted in the standardized cubicle sections made in many sizes for mounting any desired combination of units. Standard units can accommodate controllers, disconnect switches and accessories as required. Units can be mounted in both front and rear of the sections. Units are assembled either with all wiring buses, supports, terminals and interconnections already made, or with provisions for wiring on the job. Blank steel panels for mounting pushbuttons, meters and other accessories are furnished for any unused sections. A door swing-out feature facilitates wiring and change-overs. Cutler-Hammer, Inc., 315 N. 12th St., Milwaukee, Wis.

Molded Resistors

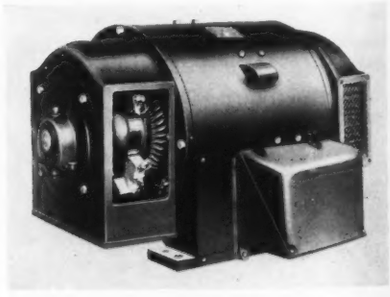
Designated Type 523, this new molded type resistor is designed to carry ½ watt load at 40 deg. C., is exceedingly compact, measures but ⅜ in. long by 0.143 in. in diameter. Wire has a specially developed alloy-coated surface that resists oxidation and retains its excellent soldering characteristics



for a long period. The unit will safely carry 100 per cent overload with less than 5 per cent change in resistance after 100 hours. Voltage coefficient is low; a 1,000 ohm unit will drop less than 0.0002 per cent per volt; a 1 megohm resistor will drop less than 0.02 per cent per volt. Produced and tested on fully automatic equipment. Erie Resistor Corp., 640 W. 10th St., Erie, Pa.

New Line of D.C. Motors

Features of this new line of d.c. motors include rolled-steel frame, improved end shield and bearing-bracket construction, coils wound with Formex wire, and a specially developed Glyptal insulating varnish which provides high resistance to impact, abrasion, and the



action of foreign materials. The motors can be furnished with sleeve or ball bearings. Other features include a lower WR^2; small diameter to permit low head room, reversal without changing any parts of the frame, fan, or brush rigging; and Textolite wedges in the armature slots. Open motors of this line in constant speed ratings are available from ½ hp. at 850 r.p.m. up to and including 60 hp. at 1,750 r.p.m.;

and in adjustable speed ratings from ½ hp. at 850/3,400 r.p.m. up to and including **15 hp. at 500/1,800 r.p.m.** Motors in the larger ratings, beginning at 50 hp., 850 r.p.m., embody additional design innovations such as a new system of self ventilation, extra protection of all current carrying and rotating parts, and large conduit boxes. A new V-type double-brush holder gives better commutation and permits rotation in either direction, and a new type lifting lug facilitates handling. General Electric Co., Schenectady, N. Y.

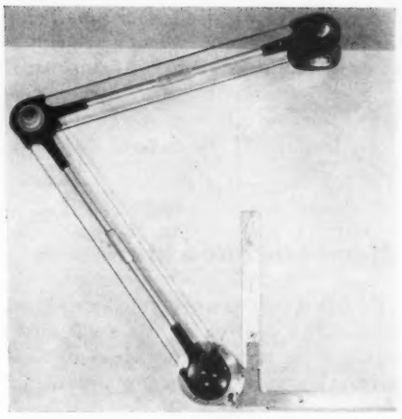
Circuit Breaker

Type M Multi-Breaker has recently been developed for use on 3-phase, 4-wire, solid neutral 120/208-volt a.c. systems. The breakers are common trip such that when an overload or short circuit occurs on any one pole, all poles trip simultaneously. The breakers are

trip-free and cannot be held closed on a short circuit or overload. Indicating handle shows clearly whether the breaker is on, off or tripped. Units are calibrated and sealed at the factory. Capacities range from 15 to 100 amp. Enameled sheet steel inclosures are furnished for either flush or surface mounting. Square D Co., Detroit, Mich.

Drafting Machine

Feature of this new drafting machine is its combination indexing. During manually controlled indexing for infrequent changes in angular position, it is operated by a thumb-piece conveniently located in the handle. For automatic indexing, the protractor arm can automatically be set and held at any multiple of 15 deg. An elbow brake, readily adjusted by a thumb screw, prevents



sliding on inclined tables. The head of this drafting machine can be raised high off the table to facilitate positioning the drawing paper; the arms are articulated for greater flexibility. Zero reading on the machine can easily be set for a baseline of any orientation. The head is supported on the paper by a large, centrally-positioned skid button of high-grade plastic. Engine divided circle is 4¾ in. in diameter and is easy to read. V & E Engineering Co., 758 South Fair Oaks, Pasadena, Calif.

Immersion Heater

The new Chromalox immersion heater, Type MF, for heating water or oil, is installed by bolting in place against a flat gasketed seat, the gasket being furnished with the heater. If the tank or container is sheet metal, a companion flange or bushing holds the

heater in place. Features include patented heating element construction for efficient heat transfer, long life and the ability to withstand electric overload. All heater surface is in contact with the liquid being heated. Copper sheath is standard for water heating, steel sheath furnished for oil heating. Available in capacities from 750 to 5,000 watts inclusive. Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh, Pa.

Rubber Base Adhesive

For the adhesion of fabric, paper, leather or other porous materials to porous or non-porous surfaces, Texglue has exceptional adhesive properties and resistance to aging. It has a latex or rubber base, is non-inflammable, has no objectionable odor, and the cement can be stored in normal atmospheric temperatures, with avoidance of freezing temperatures or heat above 90 deg. F. It can also be used for sealing packages, applying labels, and posting bulletins. The B. F. Goodrich Co., Akron, Ohio.

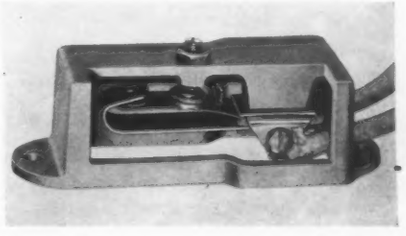
"Electrifugal" Pump

A complete pump and motor unit on one shaft and in one housing, the motor yoke and pump bracket being cast in one piece. Feet are cast integral with the housing and bracket and extend

under the entire unit instead of under the motor only. The special motor design, with copper bearing steel cover, meets NEMA specifications for splash-proof motors. Totally inclosed, fan cooled motors and explosion-proof motors are also available in sizes from 1 to 10 hp. inclusive at 3,500 r.p.m. and from ¾ to 7½ hp. inclusive at 1,750 r.p.m. for pumping against heads up to 160 ft. Standard pump construction is cast iron casing, bronze fittings. Obtainable in other special metals. The unit is described in detail in Bulletin B-6040. Allis-Chalmers Co., Milwaukee, Wis.

Thermostat

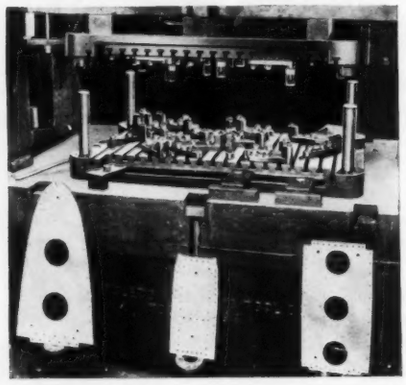
For controlling the temperature of flat electrically heated surfaces, this sturdily built element with large electrolytic silver contacts and accessible adjustment screw is mounted in a cast aluminum housing which conceals the terminals. Asbestos covered lead wire 12 in. long is supplied with each unit. Available in maximum operating temperature ranges of 300, 450 and 700 deg.



F., normally closed contacts to open with rise in temperature, or normally open contacts to close with rise in temperature, reacting to a 5 deg. F. temperature differential. Approved by Underwriters' Laboratories for 1,500 watts at 115–230 volts a.c. Adaptable for controlling air temperatures by perforating the housing. George Ulanet Co., 89 E. Kinney St., Newark, N. J.

Adjustable Die Sets

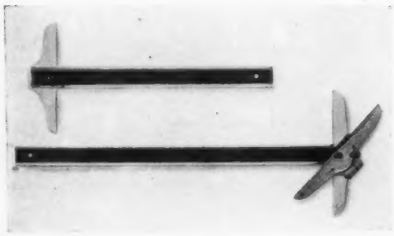
These adjustable die sets permit much closer grouping of punches and strippers than is possible by any other similar method, and permit quick and cheap production of a limited quantity of parts. Typical example is the production of small quantities of airplane



wing and fuselage sections, some of which require more than 50 perforations. Various sizes of punches for perforating and notching can be arranged in different positions to suit the requirements of the job in hand. Punches are available in stock sizes up to 1½ in. S. B. Whistler & Sons, Inc., 748 Military Road, Buffalo, N. Y.

Stainless Steel T-Square

Stainless steel T-square, known as No. 30, has transparent edges and Alumilite metal heads which make the T-square non-warpable and not affected by atmospheric changes. Rigidity is insured by double channel construction. Transparent edges are secured to the blade by dovetail joints, with no cementing. The blade is of thin cross section, requiring no bevel. Blade glides on two hard rounded surfaces that are claimed not to soil work or collect dust. Turner Devices, Inc., 12121 Mississippi Ave., St. Louis, Mo.



Hand-Operated Air Valve

Double 4-way hand-operated air valve permits the control of two individual double-acting air cylinders with only one valve. This valve has many industrial

possibilities on air-operated clamps, fixtures, knives, or any application where it is necessary to have one point of control for two cylinders that lead and lag each other in their respective action. Advantages are economies in piping, saving of air and positive control of two cylinders with one valve. C. B. Hunt & Son, 1850 E. Pershing St., Salem, Ohio.

Baking Enamel

Vedoc, a new organic finish for coating metal with a smooth hard film, requires no primer. On unprimed metal Vedoc will produce a glistening, smooth, hard finish that is unusually resistant to water, alkali and acid. It can be applied with spray or dip. It is baked at temperatures of 265 deg. F. for one hour, 325 deg. for 9 min. in gas, oil or electric ovens. It can also be baked by infra-red process. Available at present only in white and black. Claimed to have excellent color retention, Vedoc white is said to be non-yellowing. Liquid Plastics Corp., Div. Ferro Enamel Corp., Cleveland, Ohio.

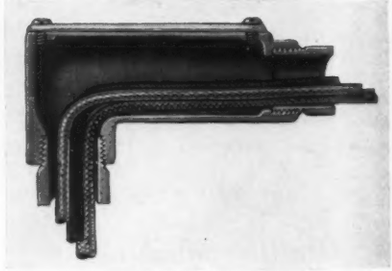
Immersion Heater

This new type of immersion heater, for operating in molten salt, metal and high temperature oil baths, is rated for use up to 950 deg. F., and is known as

Type CHS. Heavy-duty Chromalox tubular units are welded to an electrical connection housing to which a riser is attached, connections being brought out to the terminal box in which line connections are made. Operating conditions determine the use of steel or Inconel sheath, $\frac{1}{16}$-in. in thickness with wattage ratings from 2 kw. to 5 kw. at various watt densities. Edwin L. Wiegand Co., 7500 Thomas Blvd., Pittsburgh, Pa.

Conduit Fittings

An entirely different principle of interior design where right-angle turns that crack and cut the insulation are eliminated is the principal feature of the new Form 37 Adalets. In addition to the safety factor, this new interior



design eliminates mechanical abrasion, and speeds up the job of installation by making it easier to pull the wires through. Radii of the conduit hub bell-mouth curve is in accordance with the Wire Manufacturers' performance specification mandrel. The bell-mouth curve prevents sharp kinks in wires. Available in eight types. Adalet Mfg. Co., 1448 E. 49th St., Cleveland, Ohio.

Manufacturers' Publications

Materials

AMPCO METAL—Ampco Metal, Inc., 3830 W. Burnham St., Milwaukee, Wis. "Brief Facts About Ampco Metal," 16 pages, 4 x 8½ in. Descriptions and illustrations by photomicrographs of the six types of Ampco metals are included in this booklet, which covers physical properties and fabrication methods.

PLEXIGLAS—Rohm & Haas Co., Inc., 222 W. Washington Sq., Philadelphia, Pa. Booklet, 44 pages, 5½ x 8 in. Nicely illustrated booklet sets forth classified applications of Plexiglas. Table of properties is also included.

POLYVINYL ACETATES—R. & H. Chemicals Dept., E. I. du Pont de Nemours & Co., Wilmington, Del. Technical Bulletin, 8½ x 11 in. Facts concerning polyvinyl acetates, the thermoplastic resins, including information concerning different grades and specific applications, are given.

TUBULAR PRODUCTS—The Babcock & Wilcox Tube Co., Beaver Falls, Pa. Bulletin 11-C, 8½ x 11 in. Contains specifications established for carbon steel and alloy steel tubes by A.S.T.M., and specifications for high chromium and stainless alloy tubes.

STEEL FLOORING—Wm. F. Klemp Co., 6601 S. Melvina Ave., Chicago, Ill. Bulletin A.I.A. File 14-R, 8 pages, 9 x 11 in. Describes diamond grating, steel stair treads, Hexteel heavy-duty surface armor, and Klemp-Acme floorsteel, with tables of safe loads and information on assembly and recommended fillers.

Mechanical Parts

BEARINGS—Link-Belt Co., 304 W. Pershing Road, Chicago, Ill. Folder 1846, 12 pages, 4 x 8½ in. Briefly describes and illustrates the Link-Belt line of anti-friction ball and roller bearings.

CHAINS AND SPROCKETS—C. O. Bartlett & Snow Co., 6200 Harvard Ave., Cleveland, Ohio. General Catalog 90, 372 pages, 8½ x 11 in. Gives complete details of chains and sprockets, elevators, conveyors, gates, crushers, feeders, and miscellaneous materials-handling and processing equipment.

ENDLESS BELTS—The Manhattan Rubber Mfg. Division, Passaic, N. J. Drive data book lists standard sizes of two styles of Condor Whipcord endless flat belts, and lists more than 1,500 drives available with these standard stock belts.

FILTER—S. G. Frantz Co., Inc., 161 Grand St., New York, N. Y. Bulletin 15, 4 pages, 8½ x 11 in. Bulletin 16, 4 pages, 8½ x 11 in. These two bulletins illustrate and describe the Frantz FerroFilter and the Permanent Magnet FerroFilter for the extraction of iron particles from lubricating oil.

FLEXIBLE METALLIC HOSE—Seamlex Co., Inc., 5-19-48th Ave., Long Island City, N. Y. Bulletins 408 and 410, 2 pages each, 8½ x 11 in. Illustrate and list standard sizes and types of Seamlex seamless all-metal hose.

OILLESS BEARINGS—Neveroil Bearing Co., Wakefield, Mass. New catalog describes and illustrates over forty oilless alloy bearings in the Neveroil Graphex and Coprex groups, as well as oilless wood bearings in the Neveroil Woodex group.

PILLOW BLOCK — Shafer Bearing Corp., 35 E. Wacker Drive, Chicago, Ill. Bulletin 526, 4 pages, 8½ x 11 in. Condensed listings and descriptions of complete line of self-aligning pillow blocks and radial-thrust roller bearings.

ROLLER CHAINS—The Whitney Chain & Mfg. Co., Hartford, Conn. Stock List V-150, 20 pages, 8½ x 11 in. Including engineering data in condensed form necessary for the selection of chain drives, this catalog lists and gives specifications for stock roller chains and sprockets.

V-BELT DRIVES — Worthington Pump & Machinery Corp., 2 Park Ave., New York, N. Y. Engineering Manual V-1400-E2-404, 72 pages, 8¾ x 11½ in. Setting forth complete descriptions and specifications for Multi-V-Drives, this manual contains many pages of engineering information covering the selection and maintenance of V-belts.

WROUGHT WASHERS—Wrought Washer Mfg. Co., 2100 S. Bay St., Milwaukee, Wis. Stock List 55-D. Lists thousands of washer specifications in various materials, including steel, brass, copper, aluminum, and fiber now in stock.

VIBRATION INSULATORS—B. F. Goodrich Co., Akron, Ohio. Bulletin lists and illustrates extensive applications of Vibro-Insulators, the combinations of rubber and metal used to eliminate vibration.

Electrical Parts

COIL BOBBIN—Precision Paper Tube Co., 2033 W. Charleston St., Chicago, Ill. Bulletin and data sheet, 6 pages, 8½ x 11 in. Describes dielectric paper coil bobbins for applications where space is an important factor. Diagrams and illustrations set forth features.

ELECTRICAL MATERIALS—Allegheny Ludlum Steel Corp., 239 Oliver Bldg., Pittsburgh, Pa. Blue Sheet, 20 pages, 8½x11 in. Lists applications for and gives engineering data on Allegheny steels for uses where magnetic and electrical resistance properties are important.

MICRO SWITCHES — Micro Switch Corp., Freeport, Ill. Data Sheet 8A, 2 pages; Data Sheet 9A, 3 pages; and Data Sheet 14, one page; each 8½ x 11 in. Gives complete engineering description of Micro Limit Switch, Explosion-Proof Micro Switch, and die cast Metal Clad Micro Switch.

SMALL PANEL INSTRUMENTS — General Electric Co., Schenectady, N. Y. Bulletin GEA-2645A, 4 pages, 8 x 10½ in. Illustrates and gives brief description and dimension drawings for many types of small panel instruments.

SMALL PANEL INSTRUMENTS — Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. Catalog 43-350, 12 pages, 8½ x 11 in. Describes and suggests applications for the entire line of small panel instruments, approximately 3 in. in diameter.

SWITCHES—Automatic Switch Co., 41 East 11th St., New York, N. Y. Circular 500, 12 pages, 8½ x 11 in. Well illustrated bulletin contains brief description of standard switches, including automatic transfer switches, remote control switches, contactors and relays.

Fabrication Methods

NICKEL FABRICATION — Development & Research Div., International Nickel Co., 67 Wall St., New York, N. Y. Bulletin T-2, 32 pages, 8½ x 11 in. Revised as of June, 1940, this bulletin contains technical information on the welding, brazing and soft soldering of Monel, nickel and Inconel.

WELDING EQUIPMENT — Lincoln Electric Co., Cleveland, Ohio. Bulletin 402, 56 pages, 8½ x 11 in. Catalogs welding electrodes, electrode holders, protective shields, welding cables. and other welding equipment.

Miscellaneous

DRAFTING ROOM EQUIPMENT—Angle Steel Stool Co., Plainwell, Mich. Bulletin 4-16-40, 4 pages, 8½ x 11 in. Illustrates and describes many types of steel office and drafting room equipment, and includes descriptions of metal furniture for machine shops.

ELASTIC PRIMER — American Chemical Paint Co., Ambler, Pa. Bulletin 8-2, 4 pages, 4 x 8½ in. Sets forth the functions and gives directions for use of elastic primer to prevent rust on structural steel.

TACHOMETERS—Esterline & Angus Co., Inc., Indianapolis, Ind. Bulletin 640, 16 pages, 8½ x 11 in. Well-illustrated bulletin is a comprehensive and easy-to-read description of design, installation, typical applications and features of electric tachometers.

Books and Bulletins

Theory of Plates and Shells

S. TIMOSHENKO—*492 pages, 6x9 in. Black clothboard covers. Copyrighted by the United Engineering Trustees, Inc. Published by McGraw-Hill Book Co., Inc., 330 West 42nd St., New York, N. Y. Price $6.*

In this volume the discussion covering the general theory of plates is limited. Generally it is made up of investigations of particular problems and specific applications of interest to engineers who are concerned with the design of walled structures such as domes, thin-walled tanks and containers, conical and spherical shells.

Included in the text are chapters dealing with bending rectangular plates to cylindrical shapes, symmetrical bending of circular plates, deflections of laterally loaded plates, rectangular plates with various edge conditions, bending of plates under combined lateral loads and forces, and large deflections of plates. Also discussed are deformation of shells without bending, general theory of cylindrical shells, and shells having the form of a surface of revolution loaded symmetrically with respect to their axis.

Throughout the book numerous references are made to literature that treats of the problems involved in the bending of plates and shells, which should be of benefit to engineers who wish to study special problems in more detail.

Working Stresses

JOSEPH MARIN—*41 pages, 5½x8¼ in. Clothboard covers. Published by Rutgers University Press, New Brunswick, N. J. Price $1.*

An analytical comparison of various theories for evaluating the effects of combined states of stress on the failure of materials as a basis for the selection of suitable working stresses to avoid failure.

The discussion of static loads is concerned with the theories for failure of materials subjected to simple tension and to combined stresses, also with working stresses for ductile and for brittle materials. Materials subjected to fluctuating axial and to fluctuating combined stresses are also analyzed. Theories dealing with creep conditions set up in materials at high temperatures by simple tension, pure bending, torsion and combined stresses are compared and evaluated. Twenty-six plates of stress diagrams are included.

Handbook of Mathematical Tables and Formulas

RICHARD S. BURINGTON—*Second Edition, 275 pages, 5½x8 in. Black imitation leather covers. Published by Handbook Publishers, Inc., Sandusky, Ohio. Price $1.25.*

The first part of the book gives all of the important formulas of all branches of mathematics, including a comprehensive table of derivatives and greatly enlarged table of integrals. The second part includes five-place logarithm and trigonometric tables, tables of natural logarithms, exponential and hyperbole functions, reciprocals and other numerical quantities, and an improved table of squares, cubes, and roots. The book is well organized, is indexed, and content is noted at the top of each page to facilitate quick reference.

Technical Drafting

CHARLES H. SCHUMANN—*793 pages, 857 illustrations, 38 tables, 6½x9½ in. Blue clothboard covers. Published by Harper & Brothers, 49 East 33rd St., New York, N. Y. Price $3.50.*

Not only is this book a text on the subject of technical drafting, but also it is arranged so that it can easily be used as a reference for engineers. For this latter purpose, separate chapters cover the special problems of each engineering profession, such as mechanical engineering and machine elements, electrical engineering, welding, engineering graphs, industrial engineering drafting and others.

Mr. Schumann confines the elementary principles of drafting to the first part of his book, and writes it for use in modern courses where students are not required to study the theory of planes and graphics. For both elementary and advanced work, the book seems remarkably complete.

The author makes good use of actual drawings submitted by manufacturers whose drafting practice is well established. In the appendix are given many tables commonly used by draftsmen, such as standard bolt and nut dimensions, allowances for fit of parts, keyway dimensions and rivet details.

Principles of Mechanism

F. DYSON—*Third Edition. 364 pages, 5½x8½ in. Blue clothboard covers. Published by Oxford University Press, 114 Fifth Ave., New York, N. Y. Price $4.25*

The general arrangement of material in this third edition is the same as in earlier editions. New sections have been introduced which include an analysis of the sun and planet epicyclic gear, preselective epicyclic gear box; exact expression for the acceleration of a piston; mathematical expressions for displacement, velocity, and acceleration of a follower in contact with a cam face of straight or circular outline; acceleration diagram for a quick return motion. As the title indicates the text book deals with fundamental principles.

• • •

A.S.T.M. Standards On Petroleum Products

354 pages, 6x9 in. Published by Committee D-2 on Petroleum Products and Lubricants, American Society for Testing Materials, 260 S. Broad St., Philadelphia, Pa. Price $2.

Sixty-five standardized methods of testing, ten specifications and two lists of definitions of terms are compiled in this A.S.T.M. publication. The latest committee report is included, giving detailed changes on some eighteen standards and also included are three proposed new methods covering tests for neutralization number, aniline point, and for ignition quality of diesel fuels. Among the new standards included for the first time is the method for calculating viscosity index.

Ball Bearing Lubrication

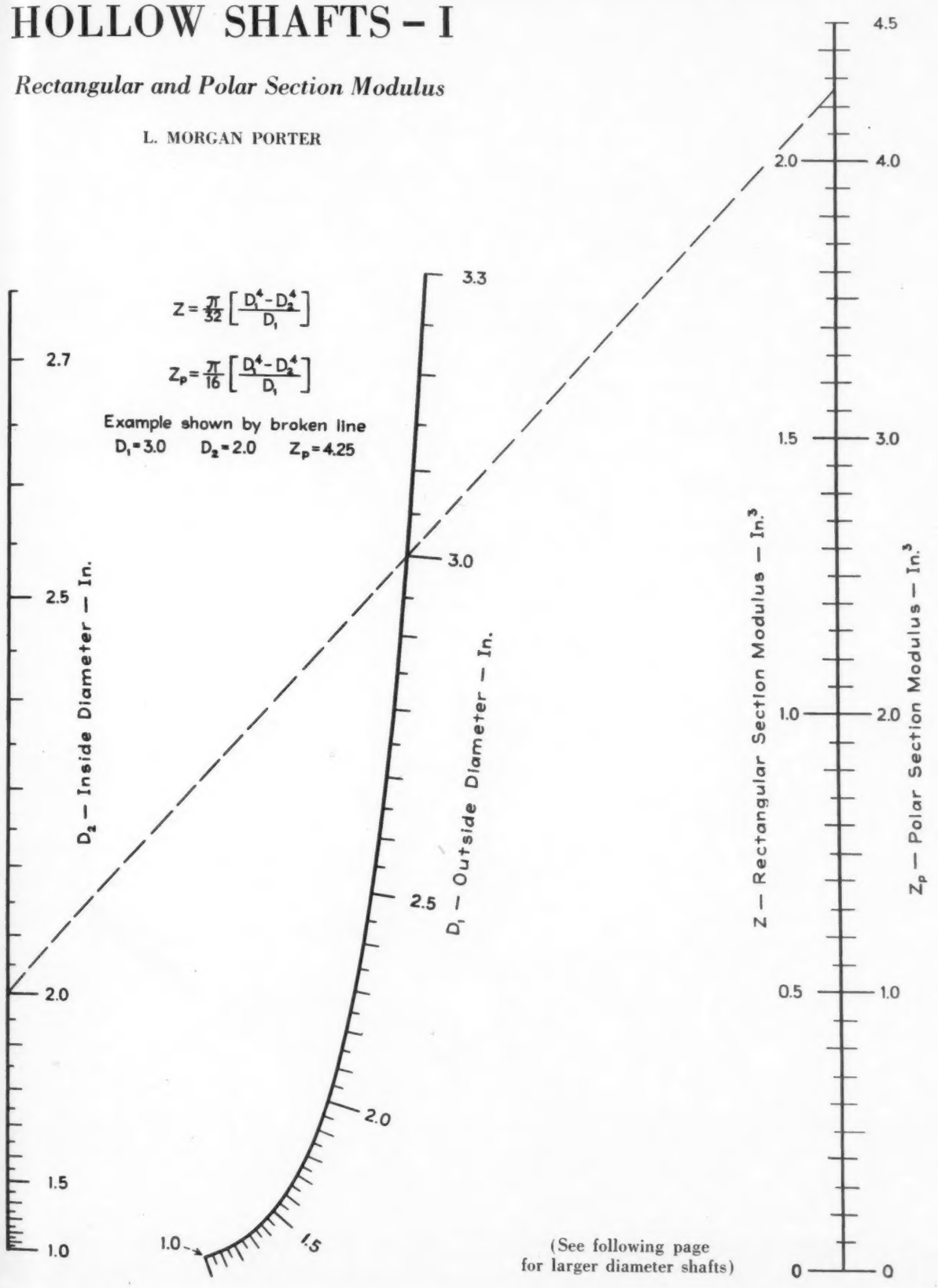
15 pages, 6½x8½ in. Published by New Departure, Div. General Motors Corp., Bristol, Conn.

This booklet, covering the selection and application of both oils and greases, is prepared as an aid to design engineers in the choice of the correct lubricant for ball bearings. A simple method for determining the proper grade and viscosity of oil for various operating temperatures and bearing speeds is given. Discussion of composition and use of greases with references to their relative suitability under different speed, temperature and moisture conditions is included. Many diagrammatic sketches illustrate different methods for applying lubricating oils and greases.

HOLLOW SHAFTS – I

Rectangular and Polar Section Modulus

L. MORGAN PORTER

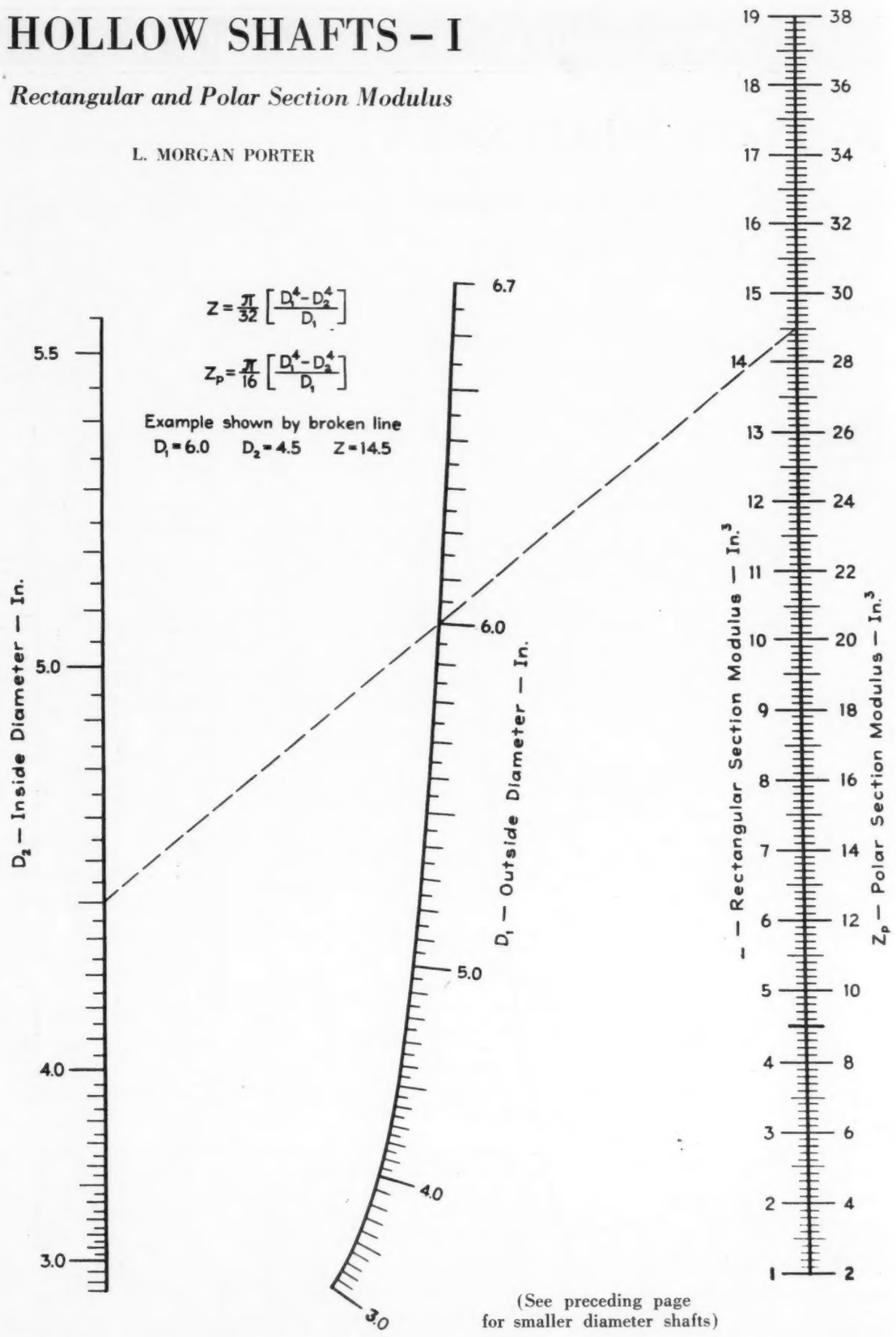


(See following page for larger diameter shafts)

HOLLOW SHAFTS – I

Rectangular and Polar Section Modulus

L. MORGAN PORTER



(See preceding page for smaller diameter shafts)

Masters of Metal . . and Many Metals

Many a widely divergent industry is represented by the parts illustrated above, but all have one common contact, for all of the parts shown are made to order by Scovill's contract manufacturing divisions.

Illustrated are screw machine products, cold headed parts, a complete radiator valve, forgings, and numerous stamped and drawn parts.

Contract manufacturing as handled by Scovill means the making to order in quantity of those metal parts or products required by other manufacturers or distributors.

The metals used in the parts illustrated above include aluminum, brass, nickel-silver, and bronze, but Scovill also manufactures from steel, copper, zinc, and other base metals. The parts may involve only a simple sand-casting operation, or they may require a series of operations ranging from blanking and drawing, through intricate piercing and forming operations, to lacquering, enameling, and finishing; but in the wide range of facilities which makes possible its diversity of production, Scovill customers have found the answer to their source of supply problems.

A WELL-KNOWN manufacturer of finely finished perfume atomizers and droppers uses metal ferrules in large quantities. In an effort to reduce his cost on these items, he wisely turned to Scovill.

Because of the line's high standards, the quality and appearance of the parts could not be sacrificed to economy. Scovill solved the problem successfully! By using a different method of manufacture, we cut down the weight of the ferrules without lowering quality, improved their appearance, and saved over 40% for the customer!

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

Whether the parts or products are for a gasoline pump, a vacuum bottle, or an oil filter for an airplane motor, the manufacturing problems have the same common ground. Scovill has successfully served many other companies by producing for them the metal parts they purchase — may we help you?

An illustrated booklet, "Masters of Metal", tells this story in further detail. Send for it. 35 Mill Street, Waterbury, Connecticut.

Boston, Providence, New York, Philadelphia, Syracuse, Pittsburgh, Detroit, Chicago, Cincinnati, San Francisco, Los Angeles.
IN CANADA: 334 King St., East, Toronto, Ontario

ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

The Navy has advanced its engineering in "face of conservatism, trepidation and no little opposition," it is told by Rear Admiral Harold G. Bowen as chief of the Bureau of Engineering, in his annual report to the Secretary. Bowen is now director of Naval research. Apparently he was referring to adoption of high-temperature, high-pressure steam. He revealed that the standard in new construction is 600 lb. per sq. in. at 850 deg. F. Machinery, under the new steam standards, is more economical, more reliable, and as easy or easier to maintain, operate, and protect in battle. His report says that top-heaviness of new destroyers, which caused so much talk, is really minor and is being corrected. The Admiral says that repair facilities afloat are inadequate and that trouble might result unless such facilities are increased, especially for the Atlantic squadron. Tests indicated that it would be desirable to put destroyer type machinery in cruisers.

* * *

Magnetic mines, as every engineer surmised, do not exist as reported by many newspapers in connection with destruction of British and neutral shipping. A little reflection convinced the technical man right away that no magnetic field could drag a mine from more than a few feet away to contact with a steel ship. Best information available in Washington is that the mines are rigged with a magnetic compass which, when deflected by a passing mass of iron or steel, closes an ignition circuit which detonates the charge. Due to the non-compressibility of water, the shallow-laid mine works as much havoc as though it were in direct contact with the ship. Such mines would not be effective in deep water. They are released by submarines, and by low-flying airplanes, supposedly suspended from parachutes. Their great destructive advantage is that they lie on the sea-floor where sweepers cannot clear them away.

* * *

"Release policy" of the Aeronautical Board, coordinator of the Army and Navy air services, has recently been revised. Now almost any aircraft in production in this country can be sold to the Allies. Only those projects which are still in the blue-print stage and in laboratory development are withheld. This is taken to mean, by many observers, that this country is giving away its military secrets to help England and France. Such, however, is not the case. Secrecy will still be maintained for the benefit of countries to whom the equipment is sold. This, of course, is rather futile, since hundreds of people know about the details of every type of airplane.

* * *

We have many secrets which are jealously guarded, even from our friends. The United States bomb sight, for instance, is far better than any other sight in the world. It constitutes a tremendous military advantage; only a handful of Americans know how it works. Then we have airplane detectors, and other devices which we will keep to ourselves. After all, with aviation moving ahead as fast as it does technologically, our main advantages are always on the drawing board and in the laboratory. Those are the advantages we are holding onto, aside from such as bombsights. Our equipment in production is only semi-secret; too many people have seen it.

* * *

An electrolytic process for recovery of manganese has been perfected and patented by the Bureau of Mines and the Bureau of Standards. It will enable the United States to produce enough high-grade manganese for defense without dependence on foreign sources. Development of the process was begun immediately after the World War when it was discovered that this country's supply was inadequate. Announcement of the process was by Dr. R. S. Dean, metallurgist of the Bureau of Mines, at the National Metal Exposition.

* * *

Firm faith in floating steel as a basic sea weapon is again reiterated by the Navy. At the same time the Navy is carefully eyeing the aerial attacks of England and Germany on each other's fleets. Now and then strong rumors drift around that naval equipment may have to be redesigned in consideration of overhead bombing. Naval tradition is slow to change, but Acting Secretary Charles Edison is a forward-looker extraordinary. Edison undoubtedly approved the bill which Congressman Carl Vinson will offer at next session for a 25 per cent expansion of the composition of the Navy—along conventional lines. Evidently the present war hasn't yet proved anything serious against the battle fleet as compared with air power. But the door was left open a crack, just in case. The bill says that the President can change the categories of construction at his discretion.

Heat-retaining properties of fabrics can be measured quickly by a new apparatus developed in the textiles section of the Bureau of Standards. Fabric is laid upon an electrically heated hot plate. Loss of heat from the plate except through the fabric to the air above it is prevented by heated guard plates. A hood is placed over the textile to prevent disturbance by air currents. Energy required to maintain the hot plate at a given temperature is observed.

* * *

The flow of death-dealing inventions to the War and Navy Departments has been greatly increased by war excitement. Not the least of recent ones is a "detonator ray," described by its sponsor as capable of exploding gasoline and ammunition at a distance of two miles. Many of the Services' most valuable developments have come from "screwbox" inventors. While most of the invention intake is fantastic, technicians examine all the stuff carefully so as not to miss anything.

* * *

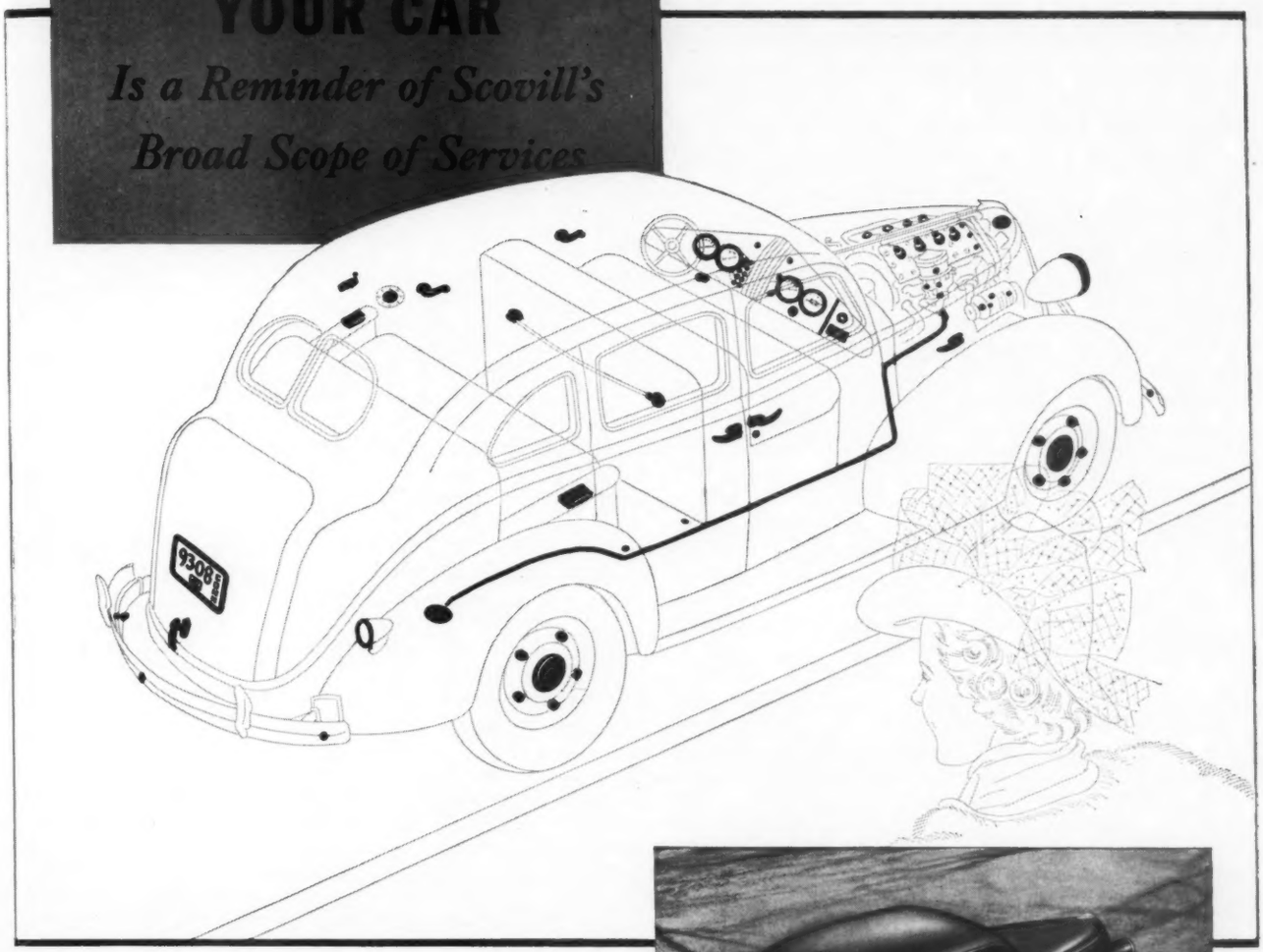
Examination of protective coatings on 1,600 underground pipe specimens which were dug up in 1937 after exposure for five to nine years, is reported by the Bureau of Standards. There is no marked difference between corrosion of ferrous materials made by different processes. Addition of small amounts of chromium, copper, nickel, etc., to iron and steel appears not to improve resistance of alloys noticeably. Ferrous alloys containing large amounts of chromium show lower loss of weight and fewer pits per unit area, but those containing chromium alone may pit deeply. Department of Commerce has available a complete report.

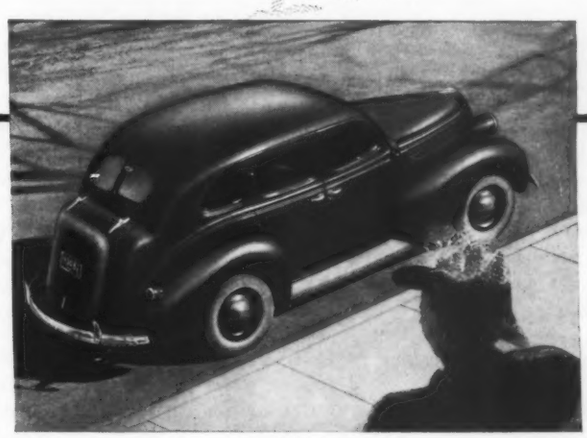
* * *

Germany has built a nautical research ship equipped with electric registers inter-connected with a master clock, reports Commercial Attache Sam E. Woods of Berlin. The devices include: an accelerometer; 14 bottom-pressure meters; optographic lamps which register simultaneously all changes of trim; dilometers to record elastic deformations caused by movement of the sea and speed of the ship; vertical rows of electric sounding devices built into both sides of the vessel to register and correlate the movement of the swells; an "Askania" angular accelerometer which can be geared to ratio of 1 to 100,000 to register pitch of the ship in heavy seas.

YOUR CAR

Is a Reminder of Scovill's Broad Scope of Services





From stem to stern you can find innumerable traces of Scovill's hand in helping other manufacturers . . . by producing metal parts in quantity to order, perhaps more economically than the customer could . . . by performing the entire production job . . . or by supplying brass, bronze or nickel silver as sheet, rod, wire or tubing, for fabrication by the customer.

Scovill's manufacturing service is as varied as the industries served. Manufacturers of such diverse products as flashlights, electric ranges, cosmetics, garden hose equipment, automobiles, X-Ray equipment, electrical appliances, etc. use Scovill as their factory for the production of drawn and stamped parts, metal part assemblies, as well as parts completely finished ready for assembly into their products. The fabrication can be from aluminum or steel as well as copper alloys, for Scovill works in all of these.

To users of turned and cold headed parts, the Scovill Screw Products Division offers a complete service, producing turned parts from the very smallest up to parts from $2\frac{3}{8}$" diameter rod and a full line of cap and machine screws and cold headed parts.

Condenser tubes, plumbers' brass goods, containers and closures are examples of products made complete by Scovill.

Thousands of firms have used Scovill's facilities to advantage . . . turn to Scovill for designing and engineering help and for the economies or improvements in quality made possible by their experience and equipment.

Our booklet "Masters of Metal" will give you an idea of the breadth of this service. Address 35 Mill Street, Waterbury, Connecticut for a free copy.

Scovill
Masters of Metal
MANUFACTURING COMPANY
WATERBURY, CONN.

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ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

A "serious lack of engine research facilities in the United States . . ." is revealed by the Lindbergh survey, announces the National Advisory Committee for Aeronautics. NACA therefore recommends that an engine laboratory, easily accessible to the aircraft industry, be constructed at the earliest possible date. This request will be sent to the present Congress. Foreign leadership in certain types of military airplanes is due in part to superiority of foreign liquid-cooled engines. In addition to its Langley Field and Sunnyvale laboratories, and the proposed engine laboratory, NACA will coordinate the work of all other facilities in the Army and Navy in universities and in industry. To carry out this plan NACA has added to its staff Mr. S. Paul Johnston, just resigned as editor of *Aviation* magazine. Mr. Johnston is a graduate of Massachusetts Institute of Technology and is a recognized authority on aeronautics. NACA has called for bids on huge wind tunnels at Sunnyvale and Langley. The Army also is building a new tunnel at Wright Field.

Best research job for the Air Corps is being done right now by Germany and England in actual combat, the toughest of all test laboratories. You may be sure that the silver-wing boys are watching intently from their swivel chairs. They've observed surprising things already, one of which is the vulnerability of bombers. During and after the World War, bombers were convoyed by light fighters. Later the bombers got so fast and maneuverable that it was thought they could go it alone, what with their universal mounting of defensive guns. But not so. One reason why Germany is delaying air attack is to take time out to build a fleet of fighters to protect bombers. The problem is different in this country, because of longer distances, but some change of policy might come.

A coordinator was set up by Charles Edison, while he was acting Secretary of the Navy, in an effort to fill the gaps between independent bureaus which work at cross purposes on ship construction. But both Edison and Rep. Carl Vinson, of Georgia, chairman of House Naval Affairs, feel that reorganization is necessary to prevent waste and such mistakes as the new top-heavy cruisers on which expensive changes will have to be made. Accordingly, Mr. Vinson has appointed a five-man sub-committee on reorganization from which he expects a report in April.

President Roosevelt stirred up the old dispute whether machines make work or unemployment in his message to Congress. He said that one problem before the country is "finding jobs faster than invention can take them away." H. W. Prentis, Jr., president of the National Association of Manufacturers, is among those who protest the President's remark. He says that 84 per cent of all machines invented are "labor serving" rather than "labor saving." Organized labor agrees with Mr. Roosevelt, says that manufacturers themselves threaten "mechanization" in answer to drives for higher wages.

"Vest-pocket" submarines are now being built in Germany, displacing 150 tons and requiring a crew of 20 as compared with 40 to 60 men for vessels of 550 to 1,500 tons. It is estimated that Germany can build the little subs ten times as fast as the big ones, and that small shipyards can be used. They could even be built in the interior and assembled on the coast. The pocket boats cannot, of course, carry enough fuel to stay out more than a few days.

Rotary wing aircraft smoke is so plentiful that you can expect to find fire. The War Department has just approved an invitation for bids on "windmills" for the Air Corps. The plan contemplates a design competition—that is, experienced manufacturers will be eligible to submit designs. This country's two leading giros are Kellett and Pitcairn. Encouragement by the Army is calculated to push civil development also. Satisfactory results are being obtained with helicopters too, by several designers in this country, following excellent work done by Germany. Many aeronautical authorities believe that private flying will get nowhere until planes are built which will be cheap and safe, and which can ignore present necessity for airports. They think the whirling blade is the basic conception.

A high speed X-ray machine, capable of taking four or five pictures a minute, has been demonstrated to the Army and the Navy. It uses paper film (emulsion on paper) in rolls 100 ft. long and 14 in. wide. Scientists here say the machine has possibilities for inspecting products on the assembly line. The intended purpose, however, is to photograph the chests and lungs of veterans applying for compensation, to protect the government against fraudulent claims. Within 23 minutes, 71 men were X-rayed.

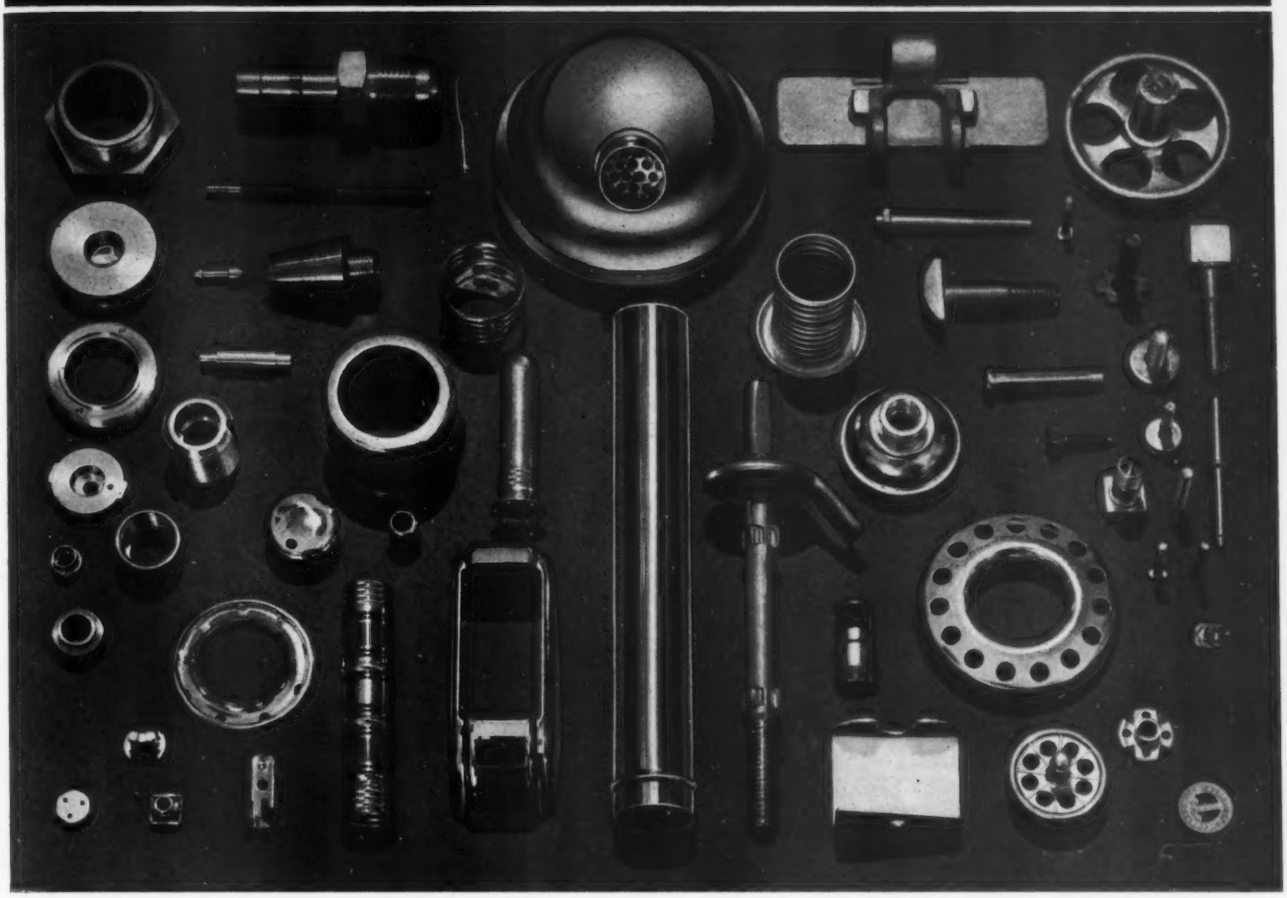
Germanium's more intense lines in the infra-red region of the arc spectrum have been photographed for the first time by Dr. Carl G. Kiess of the Bureau of Standards. Analysis of its spectrum contributes to confirmation of existing theories of atomic structure. Only minute quantities of germanium have been prepared. It shares with gallium and scandium the distinction of having had its existence foretold and its properties described by the Russian scientist Dmitri Mendeleef in 1871, prior to actual discovery in 1886 by Winkler.

Radial diesel engines, used to some extent in military tanks, are being talked up again for aircraft. National Advisory Committee for Aeronautics has experimented with diesel, and so have the Services and the industry. The Navy is watching with interest present progress on the Guiberson diesel air-cooled nine-cylinder radial, and other developments, but no extensive application in the air is imminent, say Service officers.

An oil-burner study designed to bring about understanding between buyers and sellers of domestic oil burning heating units by setting requirements satisfactory to both, has just been released by the Bureau of Standards, it was announced by Director Lyman J. Briggs. The publication includes specific requirements for oil burner construction, safety, manufacturing and production tests, and performance requirements.

Good deposits of silver have recently been made at current densities as high as 240 amp. per sq. ft., according to the Tenth Progress Report of the American Silver Producers' Project. High current densities, possible under conditions involving turbulent flow of the electrolyte, are necessary in silver-plating containers with automatic machines. Rate of deposition in some experiments was forty times normal.

300,000 Metal Helpers for American Manufacturers



The metal parts illustrated above represent a good cross section of American industry and a good cross section of Scovill contract manufacturing as well. For many a manufacturer has benefited through lower manufacturing cost, increased rate of production, greater precision of product or simplified assembly by purchasing from Scovill the metal parts he requires. Over 300,000 parts have been produced on just such a basis.

Practically any combination of operations and metals can be supplied. Illustrated are forgings, cold headed parts, screw machine products, and a number of stamped and drawn shells and assemblies. Some of the parts are shipped as they come from the tools, some have secondary operations performed while many are completely fabricated and finished by polishing, plating or enameling.

Each Scovill customer is thus served according to his needs — whether he requires a cold headed part for a machine assembly or a highly finished and chromium plated sheet metal bezel for an instrument. Few restrictions are involved for Scovill works in brass, steel, aluminum, nickel silver, zinc and other base metals.

Whatever your product may be — if you use metal parts in quantity — consult Scovill. A "Masters of Metal" booklet tells the story in further detail. Write for it to 35 Mill Street, Waterbury, Connecticut.

Scovill
MANUFACTURING COMPANY
WATERBURY, CONN.

A SIMPLER, LESS EXPENSIVE ASSEMBLY THAT WORKS BETTER!

A Venetian blind manufacturer, who had fabricated his own tilting device, asked Scovill whether a less complicated job could be turned out. We found that a cold headed part could be used instead of a screw machine product—and that by redesigning two other screw machine parts, the whole assembly was made much simpler. It costs him less to buy this tilting device, than to make it. And it is more efficient!

Boston, Providence, New York, Philadelphia, Syracuse, Pittsburgh, Detroit, Chicago, Cincinnati, San Francisco, Los Angeles.
IN CANADA: 334 King Street, East, Toronto, Ontario

ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

Educational orders remain a leading matter of interest to the metal-working industry, and therefore to designers. Of the total $34,500,000 authorized last year, to give non-military manufacturers experience in mass production of strategic military items, the unused balance of $16,250,000 is in the budget for fiscal 1941 and beyond any doubt will be appropriated. War officers and members of the House Military Affairs Committee are thinking about $20,000,000 in addition to the sixteen. In general, "orders" this year and next will cover machining of shells, new rapid fire-arms big and small, anti-tank guns, searchlights, radio listeners, new chemicals—mechanization of the Army.

In-line aircraft engines will receive increasingly serious consideration as military air speeds increase, and frontal resistance becomes more of a problem. For years volume production of radials for both military and civil planes cut power plant building costs, created profits, which have contributed to development to a point where engine failure is the exception. Some Army and Navy officers have argued that the in-line, with its liquid jacket, was highly vulnerable to bullets. But tests show that a caliber 0.30 projectile on any of the radial cylinders, which are thin, or on other vital spots, will stop the plant at once. In some instances the failure is quicker than it is in radials because of loss of liquid. Conclusion is that no aircraft engine can take gunfire; armor is out of the question thus far. One Army engine expert figures that 1,000 hp. in-line will do the same work at high speed as 1,300 hp. in radial form.

Squalus disaster was caused by human error, in the personal opinion of Navy Secretary Charles Edison. Routine diving procedure called for closing four hand-operated "hull stop valves". This was not done. If the valves had been closed before submerging, he says, only the pipe lines between inner and outer hulls, and not the compartments, would have been flooded. The Naval Court of Inquiry had absolved the officers and crew of "serious blame", and attributed the sinking to mechanical failure of the air intake valve leading to the engines. Mr. Edison says Navy's findings of fact were not entirely complete in all respects.

Mobile radio antenna developed by National Park Service engineers makes possible long distance two-way communication from motorized field equipment. Heretofore, two-way radio communication from the ordinary Park Service patrol car has been limited to a few miles. By use of new antenna—a base-loaded type with efficiency increased 16 times—communication between points more than 100 miles apart has been attained using frequencies between 2,500 and 3,500 kilocycles.

Low-flying attack planes, which dive on front lines without warning and are quickly gone, have baffled defense strategists. The U. S. thinks it has some answers. The caliber 0.30 semi-automatic shoulder rifle is one. Another effective new defense for front lines is the 37mm. anti-aircraft gun, which is fully automatic and can spray lead at the attacking plane at the rate of 125 rounds a minute. Its projectile weighs about one and one-third pounds and is fused to detonate on contact, doing serious damage. If it misses, it detonates itself after a predetermined distance, so as not to become a menace on the ground.

U. S. Navy is having sleepless nights, despite reports to the contrary, what with the war in Europe and its new unconventional Secretary Charles Edison upsetting some of its time-honored traditions. First among its problems, which also worry Congress, is whether and how to reorganize the various bureaus for more efficient ship construction. It seems that un-coordinated design actually went into those top-heavy destroyers. Another problem is whether to build battleships of 50, 60, 70 thousand tons. And the latest headache is a demand by builders for subsidy for increasing way facilities. Navy accordingly asked for accounting responsibility, which now resides with Treasury. In an under-cover dispute between the two Departments, President Roosevelt sided against his beloved Navy.

Weather information, to answer thousands of calls telephone companies in several cities are installing a voice reproducing machine which repeats the current forecast about once every 30 seconds. The forecast is a public service by local offices of the U. S. Weather Bureau. Recordings are on steel tape and connected with a number of telephone circuits. While one machine is out of service during a recording, another carries on. A third is held in reserve. As many simultaneous calls can be handled as there are communication lines available.

Weather forecasting, based on the collection of upper-air data to heights of 15½ miles by means of radio soundings from small unmanned balloons, soon will make use of a new device for measuring relative humidity which utilizes the phenomenon of variation in conductivity of a hygroscopic salt when exposed to different relative humidities. Three stations now use the device.

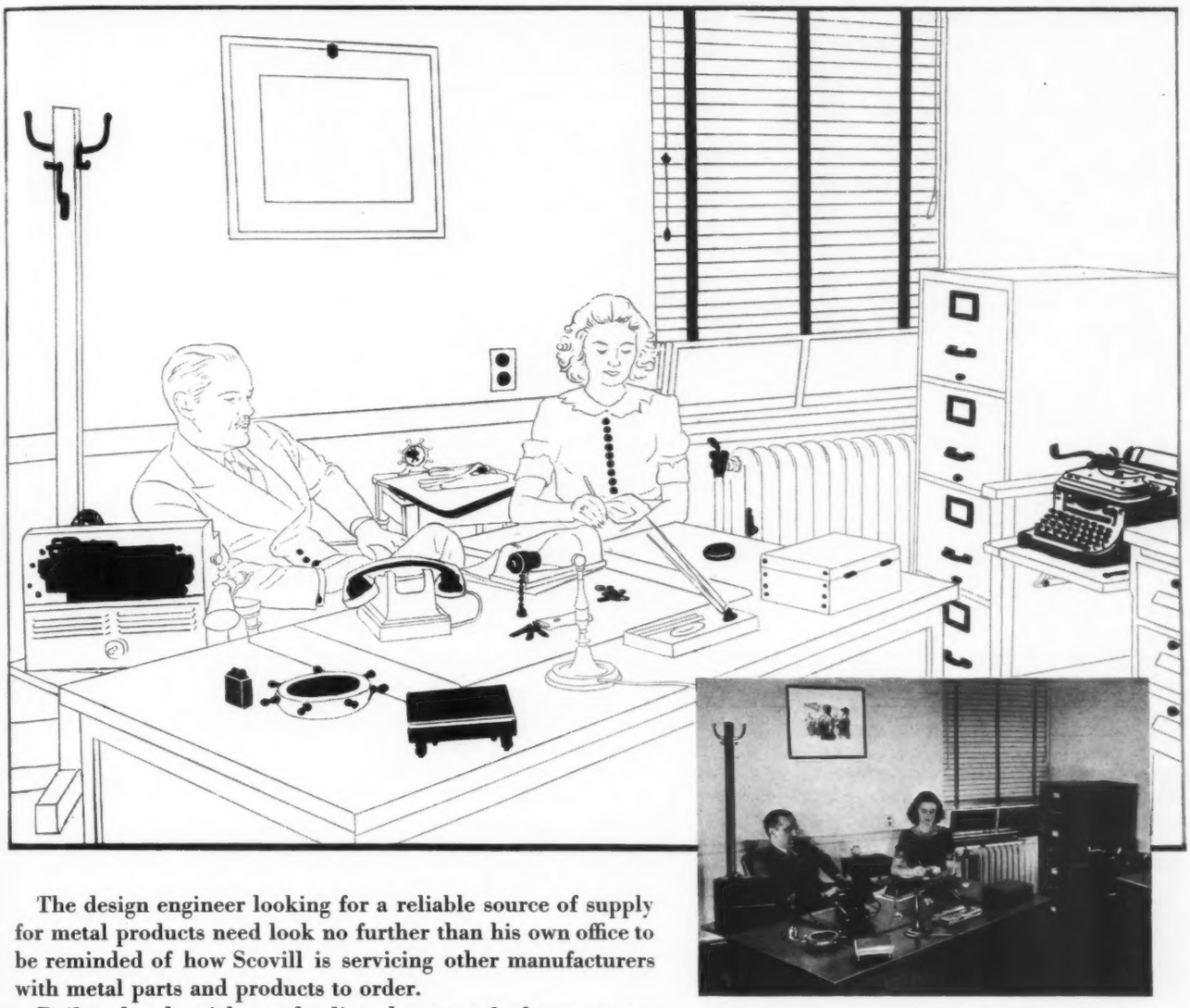
Barbed wire entanglement for the air has been developed by the War Department. A length of steel tape attached to a parachute is packed in a shell which is fired from a regular gun to a height of some 25,000 feet. At the peak of its trajectory the shell releases its pack. The 'chute opens and hundreds of feet of tape unwind and float slowly down. The wire fouls propellers and controls of attacking planes. Military authorities here are hopeful that a sky-full of such a mess will be very effective. Probably it will be tried out in the European war.

New air conditioning equipment in the Justice and Post Office buildings here has failed already to the extent that condensers have to be retubed at a cost of $15,000. It was thought at the time of installation that the steel tubing employed would be satisfactory. But the chemicals attacked the steel, and brass tubing is being substituted.

Windmill flying machines again are in the Army's eye. The Air Corps has called for a competition on autogyros. Anybody having a standing in the field can get in, with ideas on blue paper or in the air. Helicopter designs will be admitted also. A lot of first rate brains are concentrating on "hovering craft" design these days, following successful results, especially in Germany. As we've said before, some good authorities think there will be no private plane industry till its built on rotary wings.

At his finger tips . . .

TWENTY-FIVE REMINDERS OF SCOVILL



The design engineer looking for a reliable source of supply for metal products need look no further than his own office to be reminded of how Scovill is servicing other manufacturers with metal parts and products to order.

Daily, when he picks up the dictaphone or telephone, or goes to the filing cabinet—or turns on the air conditioning unit—he is making use of the products of other manufacturers who have come to Scovill for quantity economical production of their various metal manufacturing requirements. Or in his car, his kitchen, or inside a power plant—evidence of Scovill's part in industrial affairs, would be equally plentiful. For Scovill — known by some to manufacture brass sheet, by others to make brass buttons — works in many metals for many industries.

Drawn and stamped parts, metal part assemblies, as well as completely finished parts ready for assembly are produced from aluminum and steel as well as copper alloys. Turned and cold headed parts, cap and machine screws are results of Scovill's versatile manufacturing ability.

You can join the thousands of firms using Scovill's facilities to advantage —a combination of designing—engineering—manufacturing. Write today for the booklet "Masters of Metal" which gives the Scovill story in detail. Please address 35 Mill Street, Waterbury, Connecticut.

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ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

Lightweight "kickless" cartridges for all 0.30 caliber weapons will shortly be adopted by the Army. In an address before the National Rifle Association, Major-General Charles Wesson reported on successful experiments with the new bullet, which the Army is now using in all weapons except aircraft machine guns.

Aviation's most dreaded peril, engine fires, have been the subject of considerable research by the CAA engineers. According to A. A. Dallas, aeronautical engineer in charge of the CAA's experiments, a device has been perfected which will indicate immediately that a fire has broken out in the engine compartment and which will permit the pilot to extinguish the fire without leaving the plane's controls. The principles involved are not new, although this is the first time they have been applied to aircraft. The extinguishing agent is carbon dioxide, although carbon tetrachloride, methyl bromide, or a substance in powder form which produces carbon dioxide in the presence of heat, can also be used.

Luxury liner to aircraft carrier. The Maritime Commission has called for bids on two 35,000-ton liners which can be quickly converted to plane carriers for the Navy. Stacks are on the starboard side; the top deck, relatively free of obstructions, can be extended to nearly full vessel length of 759 ft. Hangar space can be provided below by burning out uprights. Of course these ships will have no armor, but Navy carriers are only thinly armored anyway; their job keeps them well away from enemy fire. These will be the largest ships ever built in American yards. Speed will be 24 knots. Liners are to be operated by a private company on the Pacific.

Bigger and better explosives, which will kill more people and destroy more of man's works much more efficiently have been described to Congressional military committees by Lester P. Barlow, bomb designer for the Glenn L. Martin Company, aircraft manufacturers. So convincing was Barlow's collection of photographs, affidavits, and other proofs of his terrible weapon that the Senators ordered the stenographic notes of the meeting burned. Barlow held patents on explosives used during the World War; sued the Government for infringement; collected $600,000. He told newsmen his new concoction is based on the use of liquid oxygen and carbon.

Technocracy again raises its automatonic head. But the idea, this time, is to chop it off. Tax concessions as a reward to employers for increasing man power and reducing mechanization have been proposed in a new bill offered in Congress. The Temporary National Economics Committee is making a study to determine whether some industries have carried technological methods too far, thereby creating unemployment. Critics here are quick to point out American creators of the machine system have been honored for taking the drudgery off men's backs. They say there is no road back; we've got to find a way to make machinery fit into our economic system.

New application of diesel power has been accomplished by the Navy in three new fleet tugs. Four engines drive a single propeller. Each engine has its own generator and motor. The vessel can be driven at fair speed by one or two of the engine-generator-motor units, the additional diesel units can be cut in for high speed, or for heavy loads, or, the unused engines can furnish power for electric towing winches. The engines are 12 cylinder, two-cycle V-type, built by General Motors.

New water meter, to analyze the rate of variation of flow of water through plumbing fixtures, has been developed by the Bureau of Standards in cooperation with the plumbing manufacturers' research association. The meter consists of an annular "bucket wheel" in a horizontal position closed around the periphery and open at the top. Its outside diameter is 50½ in. Each of the 60 compartments, of 2.5 gallon capacity, is provided with drainage fittings from which the water is drawn into volumetric glass graduates. These volumes, when plotted against time, give a curve showing variation in discharge.

Lighter-than-air design is being rescued from possible oblivion by the Navy. Secretary Edison has just submitted to Congress a report by a committee appointed to study the matter. This report points out that blimps (non-rigid airships) are valuable for patrol duty, and recommends that the Navy build them in large numbers. Medium-size dirigibles (rigid construction) should be built to continue the usual services, and to perpetuate the art through training. The Navy is advised to build experimental ships of great size later on to carry airplanes. The committee claims that the little work which has been done in buoyant flight does not justify abandonment of the art and that, furthermore, the advantages lighter-than-air does possess are greatly multiplied by the fact that this country has a world monopoly on helium.

Educational orders totaling $6,510,000 had been placed this fiscal year, as this is written. That leaves about $7,740,000 of the $14,250,000 appropriated still to be spent by July 1. It is expected most of the awards will be made within the next sixty days. That would end the program on a large scale, except that Congress is expected to authorize another big appropriation for 1941. The "orders" have been highly successful from a military point of view, and they have given many firms and individuals a new insight into munitions design.

Newest things in aerial warfare abroad are armor plate protecting pilot and engine, and "rubber" gasoline tanks, which close when punctured by bullet holes, and permit only slight leakage. The armor is thin but tough, and is angled to deflect 0.30 caliber bullets. Fifty caliber machine guns are being widely manufactured now, but they have not as yet put in an appearance in the war.

Airplanes for the Allies are becoming more and more important in U. S. foreign policy. We turned down a demand by England that our industry standardize on three types of ships to expedite delivery and maintenance in action and to reduce cost. This country wants Allied orders to aid in building up our production plant in *all* categories of military planes—not just three. But the Administration seems determined to release for export to the Allies all our models in production, reserving only our newest developments on blue paper and in development. Of course we do not let them have bomb sights, armament, and important accessories.

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by MASTERS of METAL

at a Saving in Trouble, Time and Money

Contract manufacturing by Scovill means making metal parts or products to order in quantity as required by other manufacturers. This Scovill service covers a widely diversified range of products as shown by the collection illustrated above. Forgings, drawn and cold headed parts, stampings, machine screw products are shown — in a wide variety of metals, since Scovill works in brass, steel, aluminum, copper, nickel silver, bronze, and other base metals. These products go to a long list of basically different industries.

Scovill's complete facilities permit either simple fabrication or intricate series of operations extending from blanking and drawing through piercing and forming to enameling, plating and lacquering.

Many a manufacturer has found in Scovill the successful answer to his source of supply problem. "If it's to be made of metal — try Scovill" has become standard practice, resulting in savings, for scores of industry's leading firms.

You can have the Scovill story in detail by sending for the illustrated booklet "Masters of Metal." Please address 35 Mill St., Waterbury, Connecticut.

SCOVILL INGENUITY DID THE JOB

This shell demonstrates a unique production method developed by Scovill . . . one that fulfilled unusual requirements in an economical way.

The upper half of the shell required a wall thick enough to take a thread without weakening. For the lower half, a thinner wall gave ample strength. And it was necessary that the outside diameter be uniform over its entire length.

Scovill worked out an ingenious method of manufacture that strengthened the upper half of the shell by providing the extra thickness on the inside only. The new method involved no increase in the total number of operations . . . and made a substantial saving for the customer by reducing the weight of metal in the shell.

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ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

Wage hour law on engineers, draftsmen and technicians has never been clearly defined. The result is that many employers observe the hour-week regarding these classes fearing they might be liable to suit for back wages. Many others believing that they are not covered by the law, pay little attention to the hours provisions regarding any salaried workers. Hearings now in progress at the Wage Hour Division of the Labor Department look toward clarification of the law by proper interpretation. Washington opinion is that technical professions will be exempt. An interpretative bulletin will be issued by the administration if employers continue to be dissatisfied. Exemption amendments now pending in Congress will be pushed for early approval.

War Department program of "know how" orders to manufacturers for strategic materials and munitions has been drastically curtailed by Congress to the extent of about $14,250,000. Reasons for change are the increasing orders from Europe for war supplies giving industries the desired experience without necessity of Federal educational orders.

Diesel engine application is due for wide expansion in industry and modern technique in housing afford the best outlook for new industries is the prediction of Charles F. Kettering, vice-president of General Motors Corporation, testifying at a recent meeting. Immediate trouble, is the lack of projects into which the inventive force of the nation can set its teeth. for greater development.

TNEC's hearings on technology seem to indicate that the investigation is not aimed in the direction suggested in Chairman O'Mahoney's inopportune bill which would penalize the use of machines by making tax concessions to employers who use more handcraft. Rather, the Committee's economists tend to pass over technological unemployment. What they are actually emphasizing is an economy in which public spending makes prosperity.

Theodore Kreps, a college economist borrowed by TNEC, testified that only about one third of all inventions are labor savers; about 45% create new kinds of goods, and though they do displace existing industries, they don't create unemployment. The Committee was told about another class of inventions; those that save capital. This type tends to reduce the investment required to produce a given output. It is the $500 machine which will do the work of a $1000 machine.

In 1936-37, physical industrial output was 25 per cent greater than in 1923-24, but investment in fixed capital was only 2 per cent greater. The apparent conclusion from these facts is that any vast demand for capital goods which would re-employ those dropped from displaced industries is very doubtful.

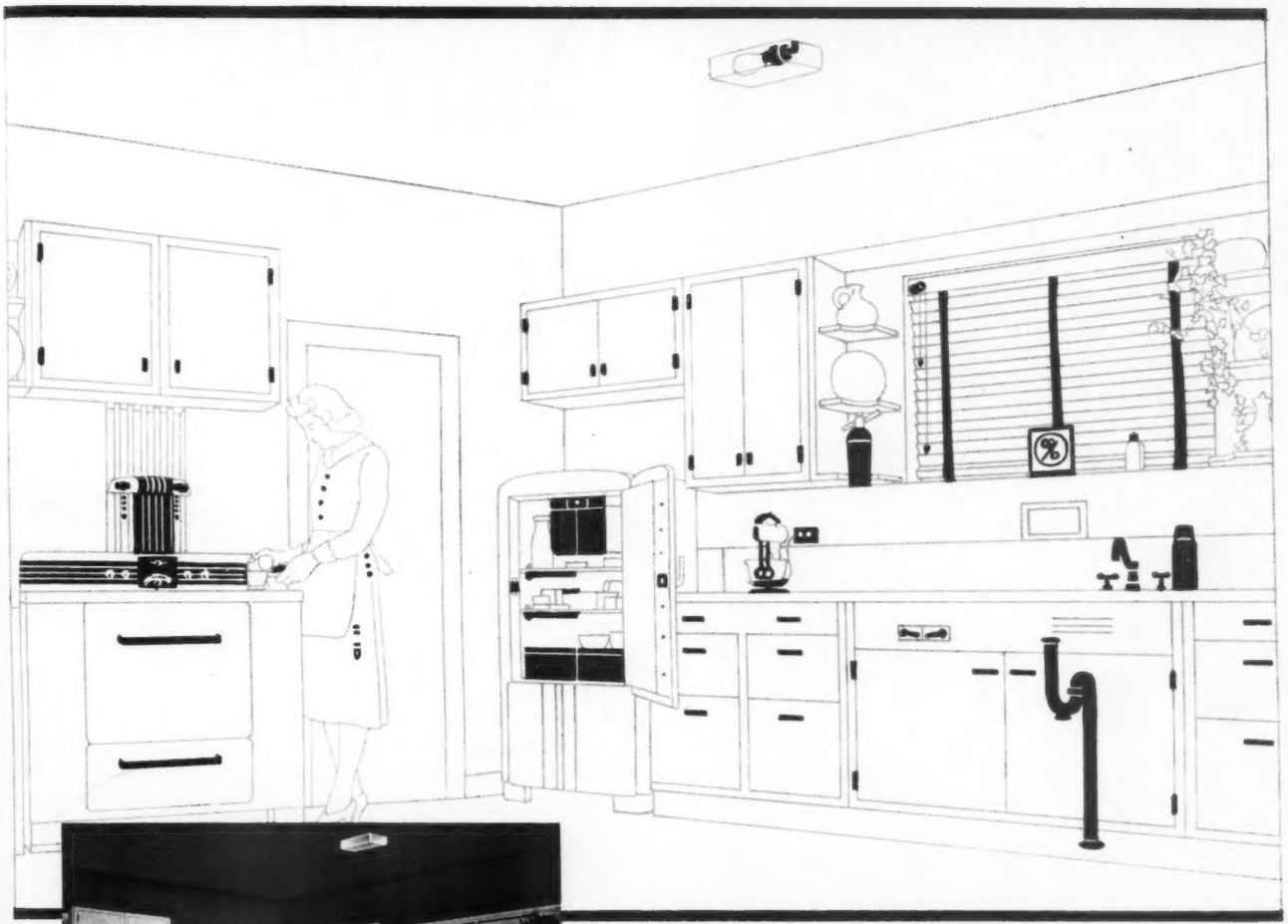
Naval war games in the Pacific this year have taken a new trend. Fleets and air services of Europe have geared the U. S. Navy to test out many new techniques, rather than devote heavy activity to war problems. Unofficially it is said the admiralty is busy studying methods of strengthening its defense at sea against aircraft. New methods of defense with mines, and the apparent failure of submarines to stop merchant and naval activity, as it did in the other war, are being tested. Far-reaching changes in naval warfare may result from the present war, although the Navy has admitted that they are not imminent as yet.

Garand rifle defects were brought out in committee hearings on War department appropriations for 1941. Total requirement of these new semi-automatic weapons is about 241,000, nearly all of which have been delivered or are in production. Investigation by Congress showed an unsatisfactory sight, inaccuracy beyond 600 yards, lubrication difficulties, poor performance with certain types of ammunition and trouble with the barrel-head. Latest production of the gun includes improved sights and a one-piece barrel. Range and accuracy are still controversial with the General Staff making a full investigation.

First all-instrument flight was made the other day by Major Carl B. McDaniel of the Air Corps. This 300-mile trip from Mitchel Field, N. Y., to Langley Field, Va., culminates ten years of engineering against stubborn odds. Eight years ago Major Albert F. Hagenberger made a blind solo flight at Dayton. But now an airplane has been lifted and set down on a distant mission, with the pilot under the hood from stand-still to stand-still. It was done in a Boeing four-engined "flying fortress" with two other officers and four enlisted men, who were not under the hood, but who gave McDaniels no help whatever. A radio directional beam was followed; radio vertical beam markers indicated the approach; the landing was made on the double beam (directional and glide path) projected by a portable plant placed at the up-wind end of runway. This achievement opens the way to extensive military operations in bad weather. Blind landing systems are being installed by the Civil Aeronautics Authority cities for experimental work by the airlines.

Twice as big as the flying fortress which weighs 30 tons is the latest announcement in the War Department aircraft building program. This new Douglas 70-ton four-engined all-metal bomber is the largest airplane in the world and will be flight-tested next summer. Among its features are 16-foot three-blade propellers, and a three-wheeled undercarriage. Cost of the initial plane will be near $1,000,000. Production units would cost about $350,000. Exaggerated reports that it would fly to Europe with 28 tons of bombs and return have been made. A round-trip attack between here and Europe is not yet possible according to War Department officials. Actually the ship is designed for operations in the Western hemisphere. The ship is intended for Army use and it will not be sold to the Allies, who are not in need of long range bombardment equipment.

World's greatest X-ray tube, developed by the General Electric Company and the Bureau of Standards, will be installed at the Bureau and ready for use by May 15. The unit stands 28½ ft. high, is composed of a series of ten elements in glass cylinders. A beam of electrons starting at the top, gets a 140,000 v. kick in each cylinder, and reaches its objective at 1,400,000 v. Its immediate purpose will be to measure X-ray dosages for malignancy. The Bureau has standardized dosage up to 400,000 v. during past years. Now it will jump to a million. This machine will do the work of $150,000,000 worth of radium, more than is now in use in the United States. X-ray laboratory will contribute much to industrial knowledge, too.



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Hundreds of other manufacturers—of refrigerators, clocks, electrical equipment, cosmetics, underwear—give Scovill the job of making parts. Because Scovill—with its wide scope of production equipment, its metallurgists and stylists, already making thousands of items of metal — can usually find a way to assist its customers in fabricating their products to sell for lower cost, or to a wider market.

Metal part assemblies, drawn and stamped parts, completely finished parts ready for assembly, cap and machine screws, turned and cold headed parts are made by Scovill from aluminum, copper alloys, steel.

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ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

Design for destruction will thrive from now till nobody knows when. The United States is beginning to rock to the rhythm of the war dance, and is off on an armament-building program that may be doubled and re-doubled. Right now opinion puts most emphasis on navy expansion and mechanization of an army a million strong. Some Congressmen are advocating expansion of aircraft building capacity to 30,000 or 50,000 a year. But this will depend on allied demand, for the military is convinced that foreign airpower cannot reach American shores in present years. Airplanes obsolesce almost annually; probably we will not build any great number of them for ourselves. Engineering will center around new army ordnance, changes in warships to withstand airplane attack, and aircraft development. Of course, despite the grim demonstration of new war gear overseas, a strong bloc in Congress, backed by substantial public opinion, will attempt to show that this country is in no danger of attack for years to come.

Air advantage over warships long had been known to progressive military experts but only suspected by laymen. Few authoritative statements were ever made till Navy Secretary Charles Edison profoundly jolted the United States the other day when he told this writer and others that airplanes have a "temporary" advantage over warships. He insisted that air bombs cannot sink battleships, but he admitted that certain naval operations within range of land air bases are now impractical. Ships now building and in service should be protected on their topsides against flying bomb fragments and splintered materials, and new construction should be "basically" redesigned above deck. Naval architects assumed he meant to put steel turtlebacks on the ships. The Secretary also said that many sides and bottoms are too thin and that they will have to be strengthened against modern mines and torpedoes.

Air supremacy over land also, as demonstrated by the Nazis in Belgium and Holland further dismayed rule-of-thumb militarists. Conservative army men who have argued for years that you cannot take and hold territory with airplanes have come out of their shells and are frankly looking around to see what's going on. As this is written, the President and his defense council are preparing to ask Congress to authorize limited expansion of air power which would serve to keep the Air Corps up-to-the-minute technologically.

Garand rifle argument was largely a waste of talking wind. It was started by a private citizen, a range marksman, who managed to snare a Garand and test it, and by an ex-marine named Johnson, who wanted to sell the army a new rifle he had invented. Statements by these men turned into a critical snow-ball which rolled right into Congress. The demonstration at Fort Belvoir, ordered by the War Department, convinced a score of members of military affairs and military appropriations committeemen that both the Garand and the Johnson are fine guns. The fact is that new weapons and products are always being submitted to War officers and many have new merits. But not enough to justify a change in the costly mass production set-up that is necessary to equip an army. War Department officials tell this writer that they are ready to go to war with the Garand. Critics said the Garand got too hot to hold when fired rapidly; that it was inaccurate over 600 yards; that it was hard to lubricate; that it fouled up and had to be dismantled and cleaned too often. Painstaking tests and reports by four division commanders seem to show that these charges are not well founded.

Farm machine designers are called upon by Fowler McCormick, vice-president of International Harvester, in testimony before TNEC, to develop implements for harvesting and loading sugar beets; a combine to pick, husk and shell corn in one continuous operation, similar to present harvesting of wheat; a sugar cane harvester—a difficult engineering job because cane varies so much in size; and a practical cotton picker. Successful beet harvesters are built, but none small enough for one-farm ownership. Farm equipment engineers are constantly in the field working with growers toward the solution of these problems.

Wage-Hour law interpretation still does not clarify the status of engineers, draftsmen, technicians. Hearings on these occupations are scheduled for June 3, probably to be followed by new interpretative bulletins. Meanwhile employers must continue to use their own judgments as to whether their workers are covered. Defeat in Congress of all wage-hour amendments, which would have modified the law was partly due to political maneuvering but mainly the result of heavy labor pressure to keep the statute intact.

Bureau of Standards has reports on a method for the application of friction and heat-dissipating data to the determination of the load-carrying capacity of a journal bearing when operating with a lubricant of known characteristics . . . On the effect of painting on the sound absorption of acoustic materials . . . On the isolation of hydrocarbons from petroleum . . . On the photochemistry of sheet materials . . . Henry W. Bearce becomes head of the Division of Weights and Measures . . . The Bureau has installed a new inertia type machine for testing brake lining, with cooperation of Brake Lining Manufacturing Association.

Industry is full of surprises, TNEC hearings on technology revealed. Edsel Ford said the Ford Company built its small rural plants near Dearborn simply "to show how a small stream could be developed hydro-electrically" and then discovered that costs were less than at the main plant. Union Pacific introduced its streamlined trains, according to Charles F. Kettering, "so people would look at a train again" and found they paid.

Dial telephone was the only machine attacked at TNEC hearings as antisocial. Union witnesses said the dial reduced employment opportunities without saving any labor—merely transferring work from employees to subscribers—while giving inferior service, particularly in emergencies. Company representatives said modern traffic could not be handled on the manual system. Other gleanings: Auto union leaders are worrying about unemployment that may be caused by the next big change expected in cars—plastic bodies, which have already been tried in Europe . . . The steering post gearshift, Ford says, has 40 parts as compared with two for the floor type . . . Payroll and purchases for each Model T, with 5,000 parts, cost $454.42; for the Model A, with 6,000 parts, $526.84; for the V-8, with 16,000 parts, payroll and purchases amounted to $683.23.

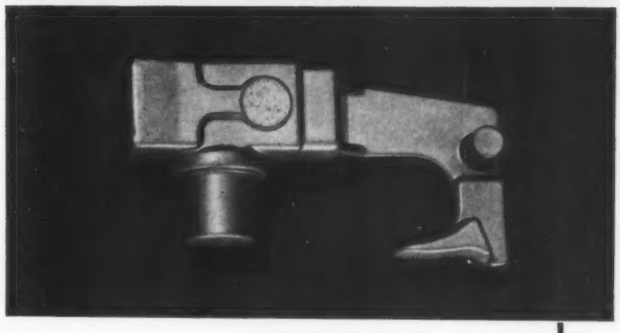
FIGHTING FIRE WITH GAS

"Fighting fire with water" is a traditional phrase but this modern fire extinguisher fights fire with carbon dioxide gas and does a good job of it, as all tests have proved.

The carbon dioxide is highly compressed and held gas-tight in the pressure cylinder — yet instantly available through the trigger-controlled release valve.

The valve mechanism, the trigger control, and the handle support on the extinguisher are, on most models, a Scovill-made brass forging. On models for use aboard aircraft where a saving in weight is important, a Scovill aluminum forging is used. The forging is 5″ long, 2¾″ high and about 2″ wide. In brass it weighs 1¼ lbs. — in aluminum 6½ ounces.

This is another of those jobs where a manufacturer's requirements for a specially-made, accurate metal part were exactly met by Scovill.



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ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

National Defense Research Commission, recently appointed by President Roosevelt, will coordinate all the country's research facilities valuable to defense development except those contributary to aircraft improvement. The National Advisory Committee for Aeronautics and the Military Services will continue to be responsible for aviation research. Dr. Vannevar Bush, member of N.A.C.A. and head of the Carnegie Institution of Washington, will head up the new Defense Research Commission. He will not resign from N.A.C.A. Other members appointed are: Dr. J. B. Conant, president of Harvard; Dr. Richard C. Tolman, California Institute of Technology; Dr. Karl Compton, president of M.I.T.; Conway P. Coe, Commissioner of Patents; Dr. Lyman J. Briggs, director of Bureau of Standards; Dr. F. B. Jewett, president of National Academy of Sciences; and Secretaries Harry Woodring and Charles Edison of Army and Navy. It was assumed that the man who succeeds the resigned Edison will also succeed to the research post. As this was written, no information was available as to what research problems will be considered first or when the commission will start work.

Automotive Engineers at their Summer Meeting announced the setting up of a National Defense Committee to coordinate wide-spread activities already undertaken by S.A.E. Military and government branches will be aided in four ways: (1) by arranging for and handling advisory services through committees; (2) by acting as liaison between the government and the technical talent of the automotive industries; (3) by providing S.A.E. representation on government committees and vice versa; (4) by developing much-needed standards. Headed up by B. B. Bachman, vice president in charge of engineering of Autocar Company and a past president of the Society, the committee includes as members: John H. Hunt, chairman of S.A.E. Standards Committee; George W. Lewis, member N.A.C.A. and S.A.E. Research Committee chairman; and Col. H. W. Alden, chairman of S.A.E. Ordnance Advisory Committee. Other members may be added. The Ordnance Advisory Committee has been collaborating with Army since World War I on mechanized equipment. Army men still remember the astounding feat of a handful of automotive engineers who, during the first war, threw together plans for the famous Liberty aircraft engine behind closed doors without stopping for sleep.

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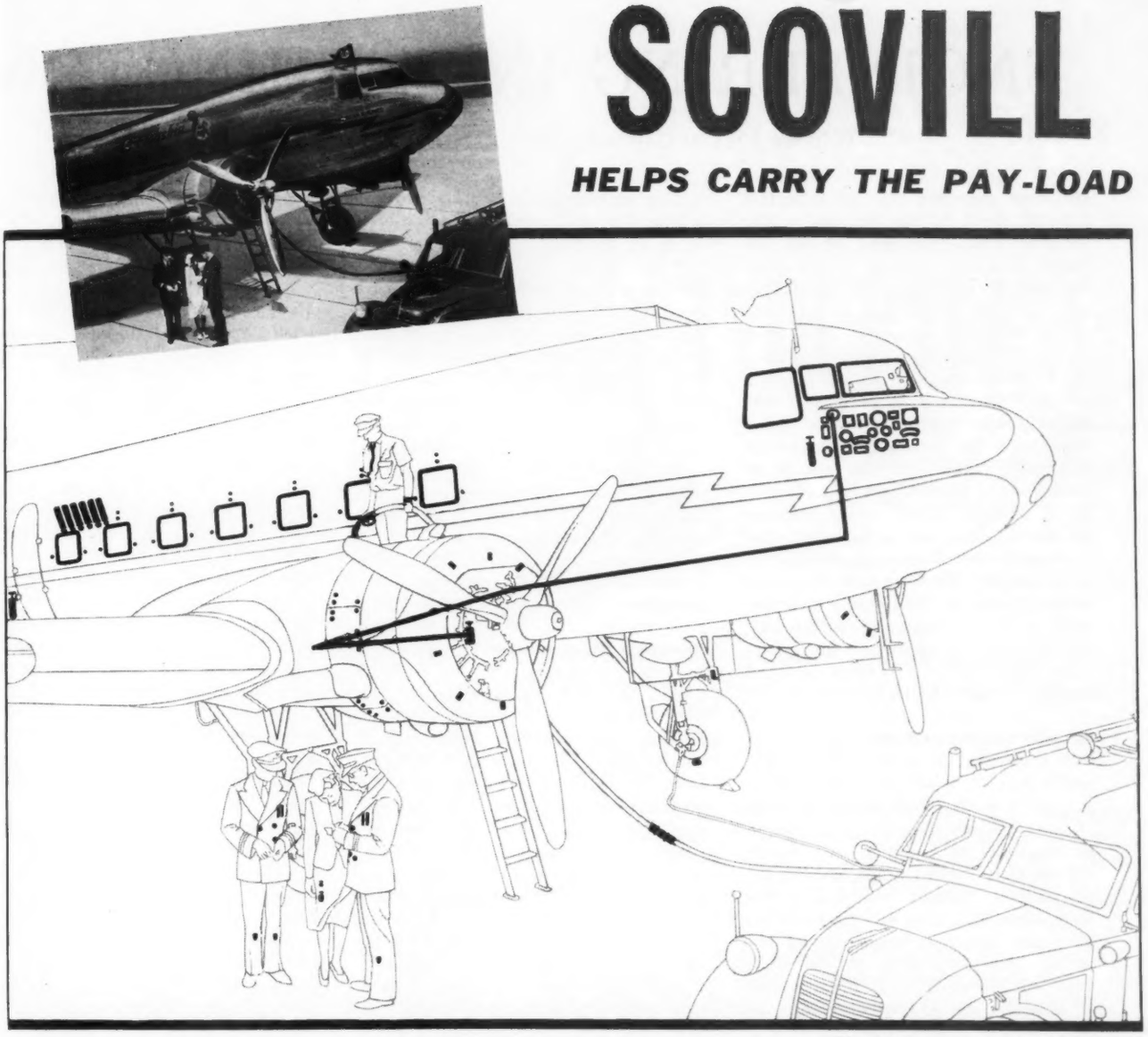

Photograph, courtesy American Airlines, Inc.

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ENGINEERING IN WASHINGTON

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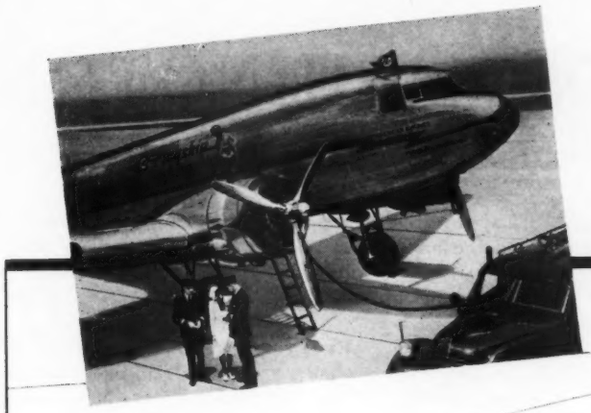

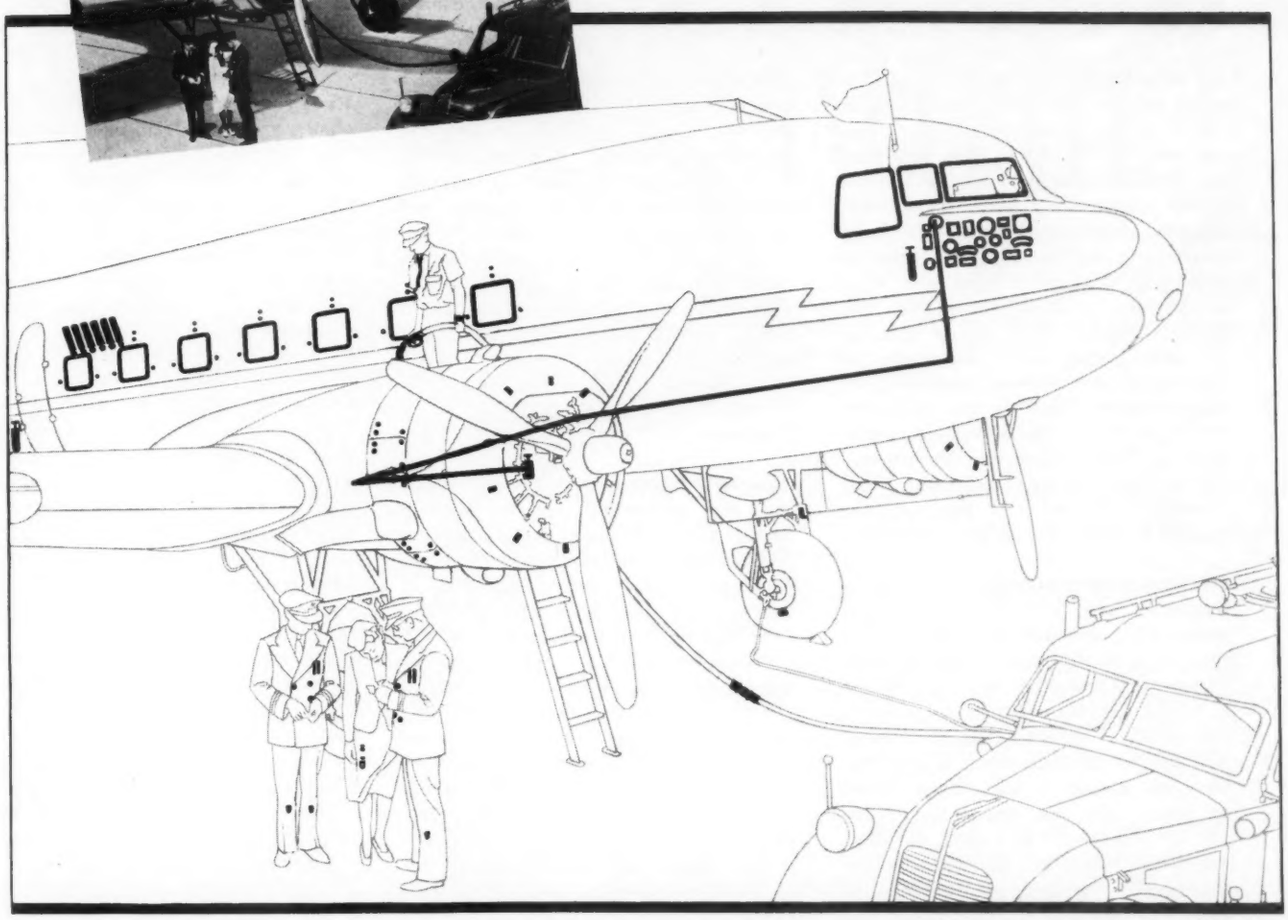

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ENGINEERING IN WASHINGTON

McGRAW-HILL WASHINGTON BUREAU, *PAUL WOOTON, CHIEF*

Defense research is an important national asset in the opinion of Dr. Vanevar Bush, chairman of the National Defense Research Commission. He says that the United States can "cut rings around any other nation in the world in the development of defense weapons." This is a broad promise, but Dr. Bush ought to know. The Research Commission is hard at work, studying defense mechanisms, at headquarters in the Carnegie Institution on peaceful P Street. If you ask What mechanisms? you will not be told. Our guess, to name three: active uranium for steam generation; a flat engine for inner-wing installation; a steam airplane engine. There is talk of a committee, maybe in the Defense Commission, to clear "ideas and inventions," which come in by hundreds, mostly screw-ball. But some of them are good enough to make the nuisance tolerable.

In electrodeposition, the concentration of material in the bath is lower within 0.012 to 0.020 in. of the cathode than it is in the body of the solution. Thus, says Abner Brenner of the Bureau of Standards, the solution from which the metal is deposited has a composition that is different from that of the body of the bath. It has been known for some time that knowledge of the cathode film would be useful, but little was done about it. Mr. Brenner has developed a method of studying the film. He freezes it on the outside of a hollow cylinder, into which is poured the refrigerant, cooled with solid carbon dioxide. He then puts the cylinder in a lathe and turns off the frozen solution in layers 0.003 to 0.005 in. thick, and analyzes it. This gives the thickness of the cathode film, and its concentration gradient.

Engine tolerances have been relaxed as a speed-up measure. Dr. George Mead, working with Treasury Secretary Henry Morganthau and Henry S. Knudsen, production man for the Defense Commission, has put the change through Army and Navy airplane specifications. Probably no engines with these wider allowances have come out of the plants as yet. You may not hear much about it when they do; resulting failures are not anticipated. American engines have developed as very fine machinery, good for 6,000 hours. It was the urge to safety in air transport that did this. But in defense we step down a bit. In action, planes may be knocked down in a day or two; in peace they go obsolete in a year or two.

Airplane standardization is now a realized fact. The Defense Commission has settled on a few leading models, including all the military types, and will stick to them regardless of pressure from engineers to make changes and improvements. Germany built its airforce on that basis. Standardization on types probably will put some of the smaller firms, not in the program, in a difficult spot. Demand for maximum production of planes, especially if England continues to fight, will force them to switch to accepted models of other companies, or subcontract parts.

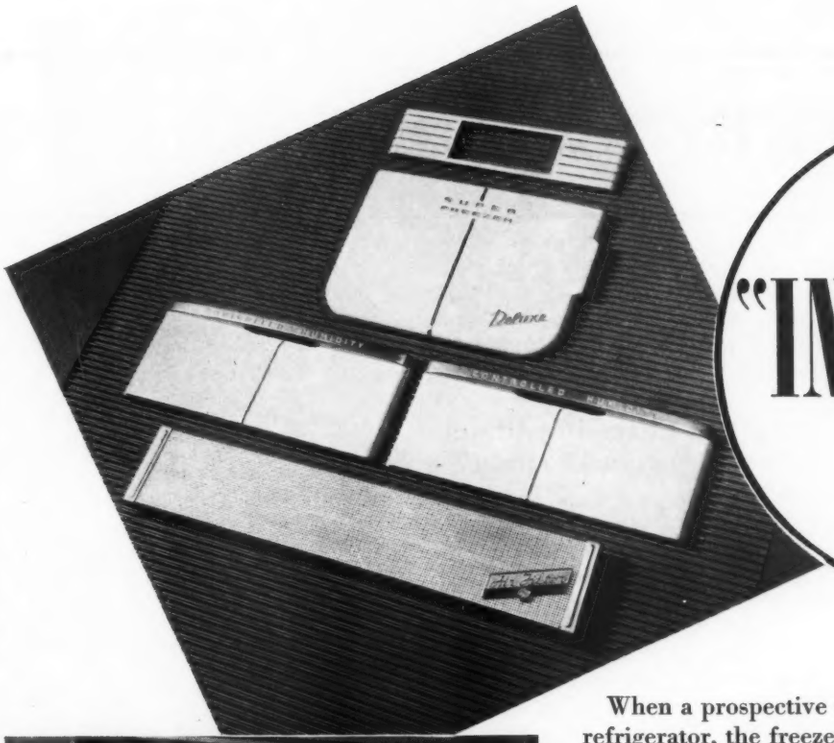
World's biggest navy is now building and authorized for the United States. It sounds reassuring to the public but plenty of responsible men in Washington wish they could feel as comfortable. Most navy authorities believe that battle fleets can stand off the best present air forces. Furthermore, air power still doesn't have enough range to worry this country from overseas. But suppose air weapons soon acquire the range and the attacking power which will cause other nations to depend on air and stop building navies? The only thing you can do with a battleship is fight another battleship, so if nobody else has one, you're embarrassed. Our navy building program will take six or ten years; we could stop it; redesign it; or go ahead with it. But we can't stop it now, merely on suspicion.

Sixteen-inch guns established at coast bases would be one way of stopping any enemy who managed to get by our navy and air defenses at sea. Shore based batteries can defeat equivalent gunpower afloat, which is unsteady. This country has not made any 16-inch guns, Army or Navy, for many years. The job of shrinking the reinforcing cylinders on the breech of the tube, boring, lining and rifling, plus breech-block fitting, sights, and carriage or mount, is difficult and complicated. There are only a couple of arsenals and possibly one or two manufacturers capable of doing it. To increase productive capacity for appreciable strengthening of coast defenses would take till nearly 1950. This is one of several phases of adequate defense which cannot be accomplished with mere appropriations; they take national determination, time, and engineering skill.

Every engineer should keep an eye on the vast skill training programs being undertaken by the government through the Office of Education, Civilian Conservation Corps, the National Youth Administration, all coordinated by the National Defense Commission, under the leadership of Sidney Hillman. It is true that nearly all of the training planned now is hand-tool and shop-tool work. But the authorities have already mentioned possible extension to engineering and design. If there are plenty of engineers now, they will want to tell the government so. If there is a shortage, the government will train more—and it will tend to put its own trainees to work rather than older men.

Strategic materials procurement is regarded much less seriously than it recently was. That is the statement of Edward R. Stettinius, in charge of raw materials for the Defense Commission. Stettinius was accused in the press of dangerous over-assurance on this subject. If his critics had been at his press conference, they would not have made such mistakes. There are hard problems to be worked out, but Stettinius sees his way through all or most of them. Example: our tin sources have or may be shut off, except South America. Even Bolivian ore is smelted in Britain. The surprising fact is that we don't know how to smelt tin. But we are getting people who do, and we will build plants. Some problems are simpler than that, but on rubber, tungsten, antimony, aluminum, toluol, optical glass, armor plate, aviation gasoline, chemicals—the boss materials man gives assurances.

German plane performance has been notably poor and the British think they have the explanation. Testing the gasoline in numerous wrecks on their soil they find octane as low as 60, and the best fuel no better than 80, which is merely good automobile gas. The implication is that the Nazis used up their good fuel in the battle of France. From that great battle comes also news that German airplane production along toward the last was very junky, indicating sacrifice in workmanship and materials in the interest of haste.



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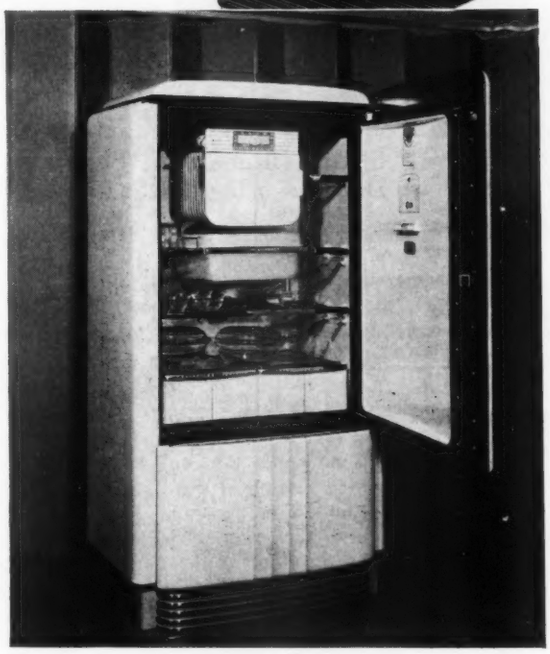

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This "Indurite" finishing process* is adding new sales appeal to such widely separate aluminum products as lipstick containers, vanity cases, refrigerator and electric range trim, and endurance to automobile license plates, dipping forms for the rubber industry and screws for aviation requirements.

"Indurite" finish is an integral part of the metal surface. It is highly resistant to damage by scratching, perspiration, heat, cold, perfume and alcohol. The finish is available in a full range of colors as well as metallic finishes, such as bronze, silver and gold color.

"Indurite" can be used with frosted metal effects, with highly finished surfaces or with enamel.

This particular finishing process is available only on parts made from aluminum, but Scovill works in many metals, supplies drawn and stamped parts, metal assemblies, screw machine products, forgings and cold headed parts as well as completely assembled products.

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ENGINEERING SOCIETIES

National Metal Congress To Be Record-Breaker

Showing every early indication of marking an epoch in the technical sessions of the American Society for Metals, the 21st National Metal Congress will be held in Cleveland, Oct. 21-25.

A.S.M. will have approximately 14 sessions besides educational lectures in the late afternoon and early evening. Cooperating societies also have programs well advanced. The American Welding Society lists 55 papers to be presented at their sessions, while the Institute of Metals and the Iron and Steel Divisions of the American Institute of Mining and Metallurgical Engineers and the Wire Association also plan extensive programs.

The National Metal Exposition, to be held in the Cleveland Public Auditorium concurrently with the National Metal Congress, at this early date exceeds the largest show that has ever been held in the history of A.S.M. More than 235 exhibitors have reserved 90,000 sq.ft. of exhibit floor.

Hotel Statler will be the headquarters for the American Society for Metals, Hotel Cleveland for the American Welding Society and the American Institute of Mining and Metallurgical Engineers, and Hotel Carter for the Wire Association.

A.S.M.E. Plans Discussions Of National Defense

Realizing that the increased tempo in design and manufacture for national-defense purposes has brought many problems which can best be solved through discussion by groups of engineers, the American Society of Mechanical Engineers plans to provide opportunities for such discussions at future meetings.

Starting in September, each of its 71 local sections will sponsor several local meetings on the engineering problems of national defense and will invite those present to make recommendations for their solution. Also planned is a series of national regional meetings which will bring together the outstanding engineers and manufacturing executives of the country to discuss the engineering phases of defense. Two of the most important of these meetings will be the fall meeting, to be held Sept. 3-6 in Spokane, Wash., and the 61st annual meeting, to be held Dec. 2-5 in New York.

Porcelain Enamel Institute Releases Forum Program

Porcelain Enamel Institute's Annual Forum will convene for the fifth time, Oct. 16-18, at the University of Illinois in Urbana. A tentative program recently released forecasts many papers of interest to design engineers.

On Wednesday afternoon, Oct. 16, there will be a symposium on the use of clays in enameling, during which several authorities on the subject will speak. Motion pictures in color will be shown on Wednesday night, one of these covering the work being done for the Institute by the National Bureau of Standards. Important papers on Thursday will include discussions of infra-red drying and the proper design of drying equipment, and stretch testing of steel and a review of the Institute's new test for the sagging of iron and steel sheets.

Meetings

American Society of Mechanical Engineers—Fall Meeting, Spokane, Wash., Sept. 3–6. C. E. Davies, secretary, 29 W. 39th St., New York, N. Y.

Society of Automotive Engineers—National Tractor Meeting, Schroeder Hotel, Milwaukee, Wis., Sept. 24–25. John A. C. Warner, secretary, 29 W. 39th St., New York, N. Y.

American Gear Manufacturers Association — 23rd Semi-Annual Convention, Skytop, Pa., Oct. 14–16. J. C. McQuiston, secretary, 602 Shields Bldg., Wilkinsburg, Pa.

Porcelain Enamel Institute—Annual Forum, University of Illinois, Urbana, Ill., Oct. 16–18. Frank E. Hodek, Jr., chairman, 612 North Michigan Ave., Chicago, Ill.

American Society for Metals—21st National Metal Congress, Cleveland, Ohio, Oct. 21–25. William H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

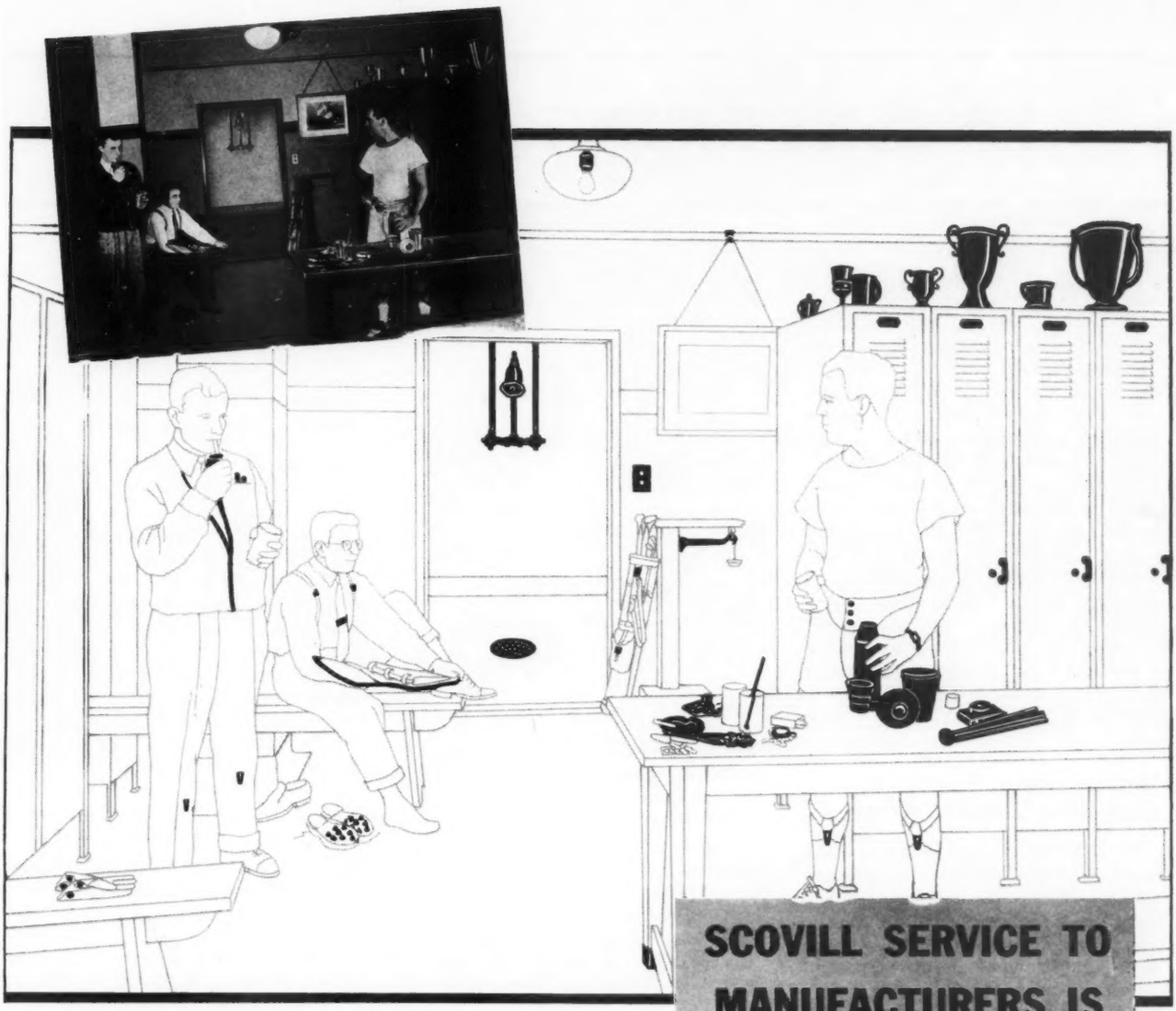
CARLTON E. STRYKER

S.A.E. Intensifies Work On Defense Aircraft Standards

Responding to strong demands from Washington sources for further increases in aircraft standards activity, the Society of Automotive Engineers recently appointed Carleton E. Stryker, well-known Pacific Coast aircraft engineer, to take charge of the Society's national defense responsibilities in establishment of standards for aircraft.

Confirming the importance of the work expected of S.A.E. in the current preparedness program, T. P. Wright, Curtiss-Wright vice president who is now consultant to the Aeronautical section of the Knudsen-headed division of the National Defense Advisory Commission, issued a statement explaining that S.A.E. would be expected to undertake consolidation of standards work pertaining to aircraft and aircraft-engine parts and materials because "it already possesses the system and the machinery for carrying out the job based on wide experience in carrying through a highly successful standardization program for many years."

Mr. Stryker comes to his post on the headquarters staff of the S.A.E. from Burbank, Calif., where he has been associated with Bendix Aviation, Ltd. He has been in the aeronautical industry since 1917, acting at one time as consultant for the Aeronautics Branch of the Department of Commerce.



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Whether the product you're concerned with is a refrigerator or a steam condenser, a lipstick or a golf shoe, a fountain pen or an adding machine, Scovill may be able to help you put it out faster, better or at less cost.

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ENGINEERING SOCIETIES

S.A.E. Creates Board For Defense Standards

Another step toward development and coordination of aircraft standardization in connection with National Defense was taken recently by the Society of Automotive Engineers with the appointment of Theodore P. Wright as chairman of their new Aeronautical Standards Board for National Defense. Mr. Wright, an international authority on aircraft design and construction, is vice-president in charge of engineering for the Curtiss-Wright Corporation, and is on leave of absence from his company to serve as executive officer of the Airplane and Engine Division, Advisory Commission to the Council of National Defense.

Defense Main Topic Of Gray Iron Annual Meeting

Problems of National Defense remain the chief point of discussion of the engineering societies, and the Annual Meeting of the Gray Iron Founders' Society, held at Cleveland, Sept. 12, was no exception. Foundry executives present from practically all parts of the United States talked about ways and means for better cooperation of foundries with the National Defense Program, and heard discussed interpretations of the Standard Terms of Sale of the gray iron industry.

A.S.T.E. Tabulates Skilled Labor Requirements

Final tabulations of technical and skilled labor requirements in U. S. industries by the American Society of Tool Engineers, reveal that more than 100,000 tool engineers, 400,000 tool and die makers, and 700,000 skilled mechanics are required immediately and for definitely planned expansion.

Underlying causes of this shortage, according to the questionnaire returns, are that the educational system has not kept pace with the machine age, that union labor's attitude has restricted use of apprentices by industry, and that industrial training programs have been slowed down and interrupted through depression years. The survey revealed that 30 per cent of plants now have apprentice training programs, and 41 per cent train men in their own way for their particular requirements. Virtually all large industrial organizations now have some form of definite program, but smaller plants have not been able to do this.

Anticipating the need for revision in training of men for industrial production, the A.S.T.E., some time ago set up a committee to develop a plan of educational and training work.

A.S.M. Sets Date For Western Metal Congress

Already organizing a general committee and making plans for another outstanding Congress, the American Society for Metals has set the date of their Western Metal Congress and Metal Exposition to be held in Los Angeles the week of May 19, 1941. This will be the fourth Western Congress, and the first one since 1938. A.S.M. feels that this Congress will be of tremendous importance, principally because of the tremendous increase in the industrial activity in the West, together with the intensive growth of the aeronautical industry in that area. Many technical societies having representation on the West Coast will participate in the activities, according to Managing Director W. H. Eisenman.

Meetings

American Gear Manufacturers Association — 23rd Semi-Annual Convention, Skytop, Pa., Oct. 14–16. J. C. McQuiston, secretary, 602 Shields Building, Wilkinsburg, Pa.

Porcelain Enamel Institute—Annual Forum, University of Illinois, Urbana, Ill., Oct. 16–18. Frank E. Hodek, Jr., chairman, 612 North Michigan Ave., Chicago, Ill.

American Society for Metals—21st National Metal Congress, Cleveland, Ohio, Oct. 21–25. William H. Eisenman, secretary, 7016 Euclid Ave., Cleveland, Ohio.

Society of Automotive Engineers — National Aircraft Production Meeting, Oct. 31–Nov. 2. Hotel Biltmore, Los Angeles, Calif. John A. C. Warner, secretary, 29 W. 39th St., New York, N. Y.

Chemical Society Hears Of Vapor-Detecting Device

An instrument so sensitive that it can determine the presence of two drops of solvent vapors in an average size room was described to the American Chemical Society at Detroit recently. Mr. V. F. Hanson, DuPont physicist, called his machine an ultra-violet photometer, and explained that photoelectric cells measure the vapors. When explored by ultra-violet light, the vapors actually cast shadows on a fluorescent screen, permitting accurate appraisal of their density. Principal uses of the machine are for the determination of the amount of solvents in air around equipment used for dry cleaning, metal degreasing and chemical manufacturing plants.

Gear Manufacturers Set For Skytop Meeting

Several interesting papers are on the docket of the semi-annual meeting of the American Gear Manufacturers Association, to be held at Skytop, Pa., Oct. 14–16. Of particular interest to design engineers will be papers on anti-friction versus plain bearings in gear cases by S. L. Crawshaw; motion characteristics of silent chains, by H. A. McAnninch; and metals which have application in worm gearing by B. A. Miller.

Power Show To Coincide With A.S.M.E. Meeting

With plant expansion under way or definitely projected in more than half the nation's metal working establishments, manufacturers of power plant equipment and mill supplies are showing a lively interest in the business prospect, as evidenced by the way reservations for exhibition space at the National Exposition of Power and Mechanical Engineering are rapidly being gobbled up. The Power Show will be held in Grand Central Palace, New York, Dec. 2–7, coincident with the annual meeting of the A.S.M.E. To date more than 270 concerns have contracted for space to display their products.

SCOVILL *Offers* ANOTHER AID TO AMERICAN INDUSTRY

Boots Self-Locking Nuts Now Made in Wing Style

Where a strong, vibration-resisting nut is required, the Boots Self-Locking Wing Style Nut will find useful applications in many industries. It has outstanding advantages: self-locking—vibration resistant—easily assembled—reduced weight—all metal, one-piece construction—no deterioration. The hexagon "wing" style, illustrated, has all the advantages of a solid type nut but is 10% to 50% lighter and generally, size for size, costs less. Fabricated from steel, cadmium plated, the nuts are available in sizes from No.6 through ¼".

We suggest its application on electric switch gear, electric motors, appliances, vacuum cleaners, automobile horns, water and gasoline pump meters, as adjusters on automobile headlights, as well as for use on telephone, telegraph and radio transmitters and communication systems.

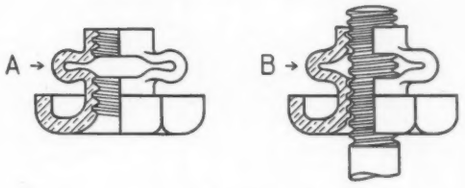
Variations of this nut built around the "wing" style locking principle can be supplied for special purposes.

Samples of the Boots "wing" style hexagon nuts will be sent upon request in sizes from No.6 through ¼". Please address 35 Mill Street, Waterbury, Connecticut.

Manufactured and Distributed for

BOOTS AIRCRAFT NUT CORPORATION

HOW IT WORKS



The construction of Boots "wing" style hexagon nuts is shown in the illustration.

The left illustration shows the nut when not in use on a screw or bolt. Note the position of the spring member as shown at arrow "A."

The right illustration shows the nut in use. Note at arrow "B" that the spring member is expanded to its locking position.

The threads in the nut member are pushing "up" —the threads in the locking member "down." This constant tension locks the nut firmly into position, and only a wrench applied to the nut will loosen or remove it.

Scovill

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ENGINEERING SOCIETIES

British Periodicals Still Received by Library

In spite of the war, the Engineering Societies Library in New York is experiencing no difficulty in its receipt of technical periodicals from Great Britain. The 350 or more periodicals from England and other parts of the British Empire are coming through with unusual regularity except in one or two instances when the ship carrying a batch of them has been sunk. All such lost copies have since been replaced.

The Allied blockade of Germany failed to stop the flow of German magazines through Italy. But, with the entrance of the latter country into the war, the library failed to receive German and Italian publications for several months. Now, some of the German periodicals are being received through Siberia and Japan. French periodicals ceased arriving at the library a few weeks after the surrender of France.

In cases where it is impossible to mail periodicals to this country, arrangements have been made with foreign publishers to store all undelivered copies until the termination of the war.

Plastics Industry Sets Up Information Clearing House

Growing like Topsy, the Society of the Plastics Industry collected more than 150 members of plastic material manufacturing companies, molding companies and plastic press machinery manufacturing companies for its fall meeting. Oct. 13–15 at Shawnee-on-Delaware, Pa. Announced at the meeting were permanent offices of the S.P.I. where will be set up for the first time a central clearing house for information on plastic materials. There will be assembled data on sales of raw materials, finished products, sources of supply, employment opportunities and reliable information for the use of manufacturers, the government, institutions and the general public.

A.S.M.E. Annual Meeting To Attract 5,000 Engineers

Keynoting better living and greater industrial progress through engineering, the sixty-first annual meeting of the American Society of Mechanical Engineers to be held in New York City, Dec. 2–6, 1940, with meeting headquarters at the Hotel Astor, is expected to attract about 5,000 engineers and executives from the United States and Canada. More than 100 technical papers on such specialized mechanical-engineering subjects as aeronautics, applied mechanics, fuels, hydraulics, metals engineering, petroleum, steam power, railroads, and many others will be presented by leading experts in the field. To accommodate all of these papers, 44 simultaneous sessions are being scheduled. In view of the increasing attention being given to applications of plastics and rubber, four papers on these subjects will be presented at special sessions.

Glenn L. Martin Awarded Daniel Guggenheim Medal

The Daniel Guggenheim Medal for 1940 has been awarded to Glenn L. Martin, president of the Glenn L. Martin Company of Baltimore, it was announced recently by Elmer A. Sperry, chairman of the Board of Award. The gold medal, which is to be presented at the Honors Night Dinner of the Institute of the Aeronautical Sciences in New York on Jan. 28, 1941, was established in 1928 and is given "for contributions to aeronautical development and the production of many types of aircraft of high performance."

Mr. Martin is an Honorary Fellow and past president of the Institute of Aeronautical Sciences. He has been a manufacturer of airplanes since 1909, in which year he built his first plane and taught himself to fly. Mr. Martin received the Collier trophy in 1932.

Meetings

Society of Automotive Engineers—National Fuels and Lubricants meeting, Hotel Mayo, Tulsa, Okla., Nov. 7–8. John A. C. Warner, secretary, 29 W. 39th St., New York, N. Y.

American Society of Mechanical Engineers—Annual Meeting, New York, N. Y., Dec. 2–5. C. E. Davies, secretary, 29 W. 39th St., New York, N. Y.

Power and Mechanical Engineering—Fourteenth National Exposition, Grand Central Palace, New York N. Y., Dec. 2–7. International Exposition Co., Grand Central Palace, New York, N. Y.

Society of Automotive Engineers—Annual Meeting, Book-Cadillac Hotel, Detroit, Mich., Jan. 6–10, 1941. John A. C. Warner, secretary, 29 W. 39th St., New York, N. Y.

Mass Production Has Been Basis of Aircraft Design

Although it is not generally appreciated by the public, the aircraft industry in general has in the last six years successfully planned its projects with mass production as the first premise, according to a paper presented by Don R. Berlin and Peter F. Rossmann at the recent National Aircraft Production meeting of the Society of Automotive Engineers, held in Los Angeles.

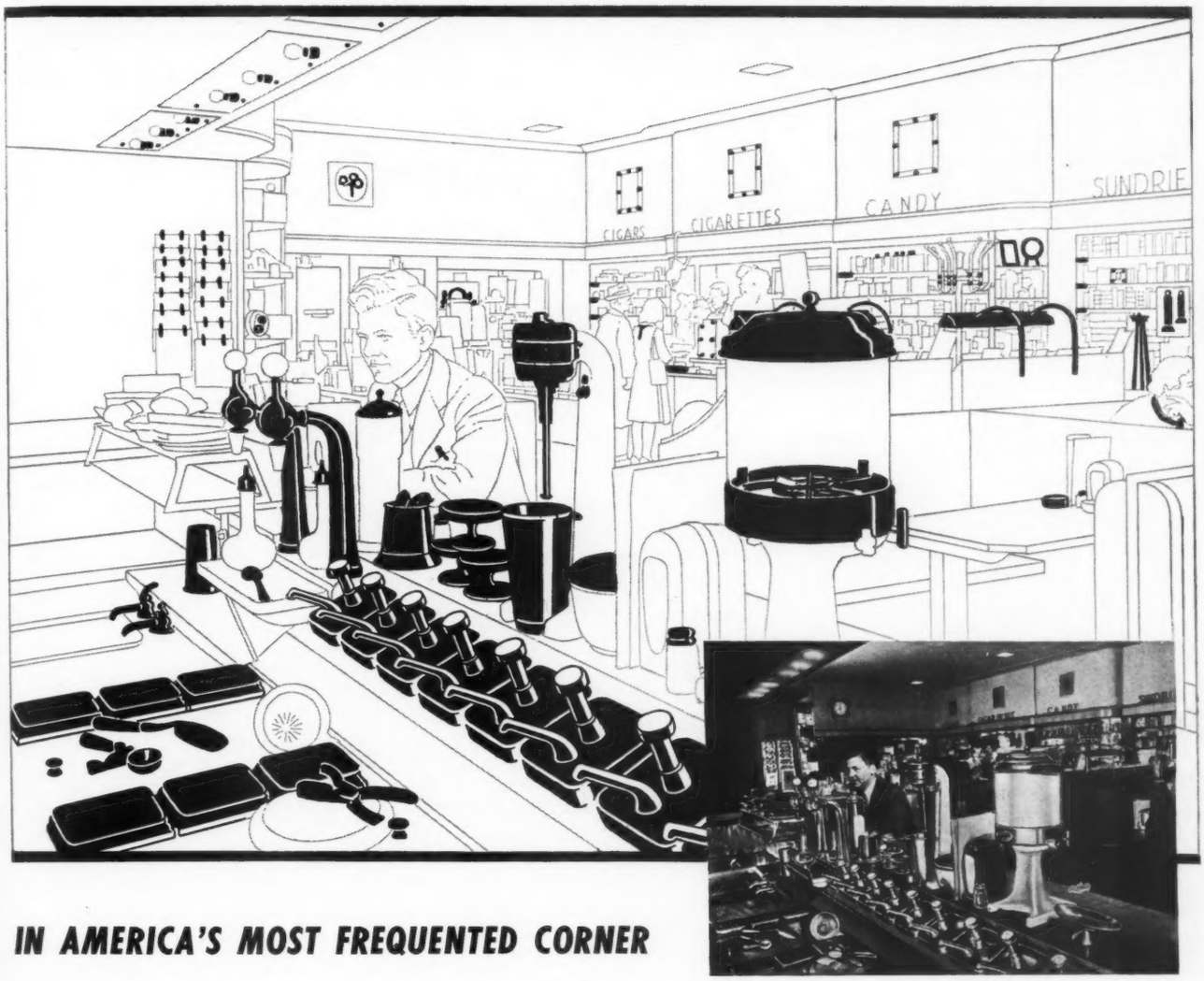
Engineering trends together with manufacturing processes have been directed to bring about the requisite high industrial efficiency by the adoption of manufacturing methods and design techniques used in other mass production fields, so that this country's aircraft industry is now in a position to take advantage of the increased rate of production. Other papers presented at the meeting amplified this statement.

French and Armstrong Awarded Lincoln Medal

H. J. French and T. N. Armstrong, metallurgists of the Development and Research Division of the International Nickel Company, have been awarded the Lincoln Gold Medal for 1940 for their technical paper entitled "Weld Hardening of Carbon and Alloy Steels."

This paper was originally presented before the American Welding Society at the 1939 National Metal Congress in Chicago, and subsequently appeared in the October, 1939, *Welding Journal*. The Lincoln Gold Medal is given each year to the author or authors contributing most to the development and advancement of welding. Presentation of the medals was made at the annual meeting of the American Welding Society, Oct. 21, 1940, in Cleveland.

SIGNS OF SCOVILL . . .



IN AMERICA'S MOST FREQUENTED CORNER

Remember the picture on this page — the next time you are in a drug store. Here is an idea of Scovill's diversified contributions to industry and your every-day life.

When the soda fountain attendant mixes a drink, squeezes an orange, or dips ice cream he is probably using equipment either Scovill-made or with Scovill-made parts.

When your secretary buys a vanity case, novelty jewelry, or a pencil; when your salesman buys a razor, a traveling kit of toilet accessories, or a flashlight — they are probably being indirectly served by Scovill, for this company through its mills and contract manufacturing departments is a source of supply to thousands of customers for varied products.

To some, Scovill supplies the mill products from which the articles are made or the screws and rivets with which they are assembled. Others use Scovill's facilities as a source of supply for metal parts ready for assembly or for complete metal products ready for sale.

Each customer can be served according to his needs for in the working of base metals (steel and aluminum as well as brass, nickel silver and copper) — in stamping, drawing, forming, forging, machining, plating, buffing and polishing — Scovill is a specialist.

Why not find out how you, too, can profitably *come to Scovill* and use this comprehensive service. Write for the booklet "Masters of Metal." It's free — write to 35 Mill Street, Waterbury, Connecticut.

Scovill
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ENGINEERING SOCIETIES

Engineering Council Prepares Professional Code of Ethics

A Code of Ethics for the engineering profession, which will form the basis for action by member societies of American Engineering Council in adapting it to their specific requirements, is now in preparation, according to President Alonzo J. Hammond. Preparation of this code has been entrusted to a newly formed committee headed by Dugdale C. Jackson, professor emeritus of M.I.T. who will represent the A.I.E.E. and the A.I.C.E. Dr. William H. Kenerson of Brown University will represent the A.S.M.E. Other members include Arthur W. Dean, retired chief engineer of the Massachusetts State Tiling Board, Dean J. W. Barker, and Dr. Scott Turner.

Packaging Institute Offers Services to Government

One hundred executives from companies in the packaging production, machinery and supply fields voted unanimously to offer the services of the Institute to the government, at the annual meeting of the Packaging Institute held Oct. 10. This action will benefit the consumer by changes in packaging standards, and will aid the government where the experience and wide technical knowledge of the Institute's membership may result in the establishment of standards for the packaging of government-purchased supplies and the conservation of essential materials. Carl H. Lambelet, president of New Jersey Machine Corporation, succeeds William M. Bristol, Jr., Bristol-Myers Co., as president of the Institute. Vice-presidents elected at the meeting were George R. Webber, Standard Brands, Inc., and A. Vernon Shannon, Westfield River Paper Company.

Bessemer Steel Process Needs Better Control

Predicting that eventually the Bessemer process would be controlled with a precision impossible in the open hearth process, Mr. H. W. Graham, director of research of the Jones & Laughlin Steel Corporation, stated that "if the Bessemer process were given a portion of the lavish technical aid provided for the open-hearth process, it might retain its proportionate place, and retain its undoubted inherent advantages," in his paper before the American Institute of Mining & Metallurgical Engineers at the National Metal Congress. According to Mr. Graham, the present level of production of Bessemer steel is much too low for a correct balance of process within the steel industry. Attention was focused on Mr. Graham's remarks by the fact that Jones & Laughlin recently developed a method for controlling the Bessemer blow by photoelectric cells (PRODUCT ENGINEERING, July, 1939, p. 307).

Engineering Foundation Holds Annual Meeting

Research in science and engineering received another boost from the Engineering Foundation at the annual meeting held Oct. 17, when 24 research projects were endorsed by the Board for continued support during the coming year. Projects include investigations in problems of hydraulics; alloys of iron and friction and creep of metal; critical pressure steam boilers; fluid meters; cold rolling steel; paper insulation, and welding. Dr. O. E. Buckley, president of Bell Telephone Laboratories, was re-elected chairman.

Meetings

American Society of Mechanical Engineers—Annual Meeting, New York, N. Y., Dec. 2-5. C. E. Davies, secretary, 29 W. 39th St., New York, N. Y.

Power and Mechanical Engineering—Fourteenth National Exposition, Grand Central Palace, New York, N. Y., Dec. 2-7. International Exposition Co., Grand Central Palace, New York, N. Y.

Society of Automotive Engineers—Annual Meeting, Book - Cadillac Hotel, Detroit, Mich., Jan. 6-10, 1941. John A. C. Warner, secretary, 29 W. 39th St., New York, N. Y.

American Institute of Electrical Engineers — Winter Convention, Philadelphia, Pa., Jan. 27-30, 1941. H. H. Henline, secretary, 29 W. 39th St., New York, N. Y.

Duplicate Books Worry Engineering Library

A chance for engineering libraries all over the country to increase their collections exists in the 25,000 duplicate books and pamphlets held by the Engineering Societies Library in New York, declared Director Harrison W. Craver recently. These duplicate publications are creating a problem in the library for which no satisfactory solution is apparent, and storage is fast becoming a burden upon limited space. Dr. Craver expressed the hope that representatives of engineering libraries coming to New York would look over the duplicate collection and select items that would be of use to them. These, said Dr. Craver, would be gladly donated provided arrangements were made to cover the cost of shipment.

Lehigh University Sponsors Symposium on Plastics

Several hundred invited representatives of America's leading laminating and molding interests attended the first Lehigh-sponsored symposium on plastics, October 25, at Lehigh University. Highlights of the meeting were the announcement of commercial production of cast technical resins for chemical linings, an illuminating address by Dr. M. H. Bigelow on the properties and uses of urea formaldehyde resins, and a talk by Mr. H. N. Haut, chief inspector of the Bellanca Airplane Corporation, giving a comprehensive review of plastics in airplane construction. Mr. Haut stated that a long series of exhaustive tests definitely prove the superiority of a low-temperature cement over other bonding mediums commonly used in the assembly of large laminated plastic airplane sections.

National Chemical Exposition To Be Held in Chicago

Latest developments in chemical equipment and products will be on display at the National Chemical Exposition in the Stevens Hotel, Chicago, Dec. 11 to 15. The exhibits, together with an educational and scientific display dramatizing recent chemical progress, are expected to attract an estimated 20,000 technical and production men.

PRODUCT ENGINEERING

JANUARY, 1940

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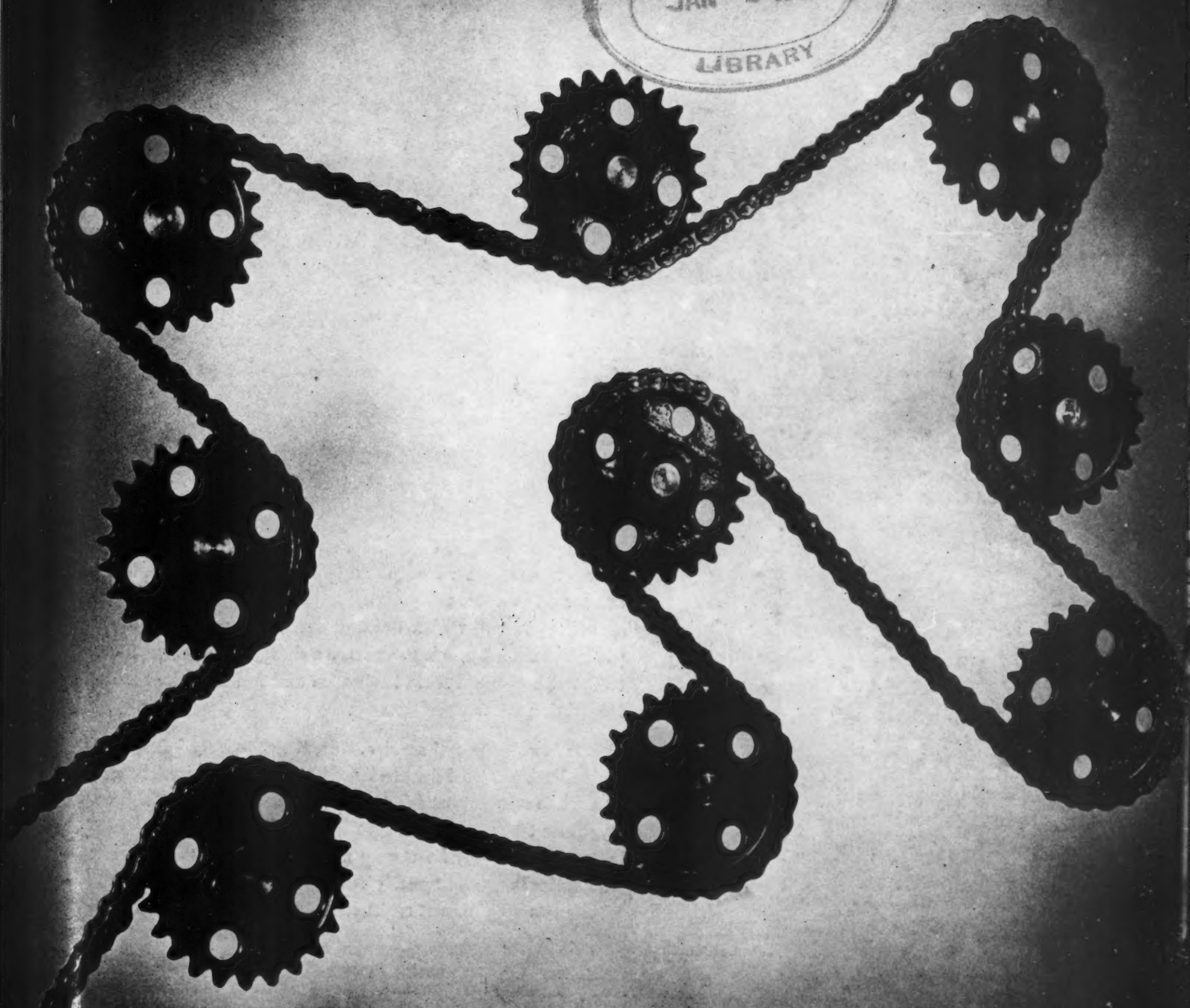
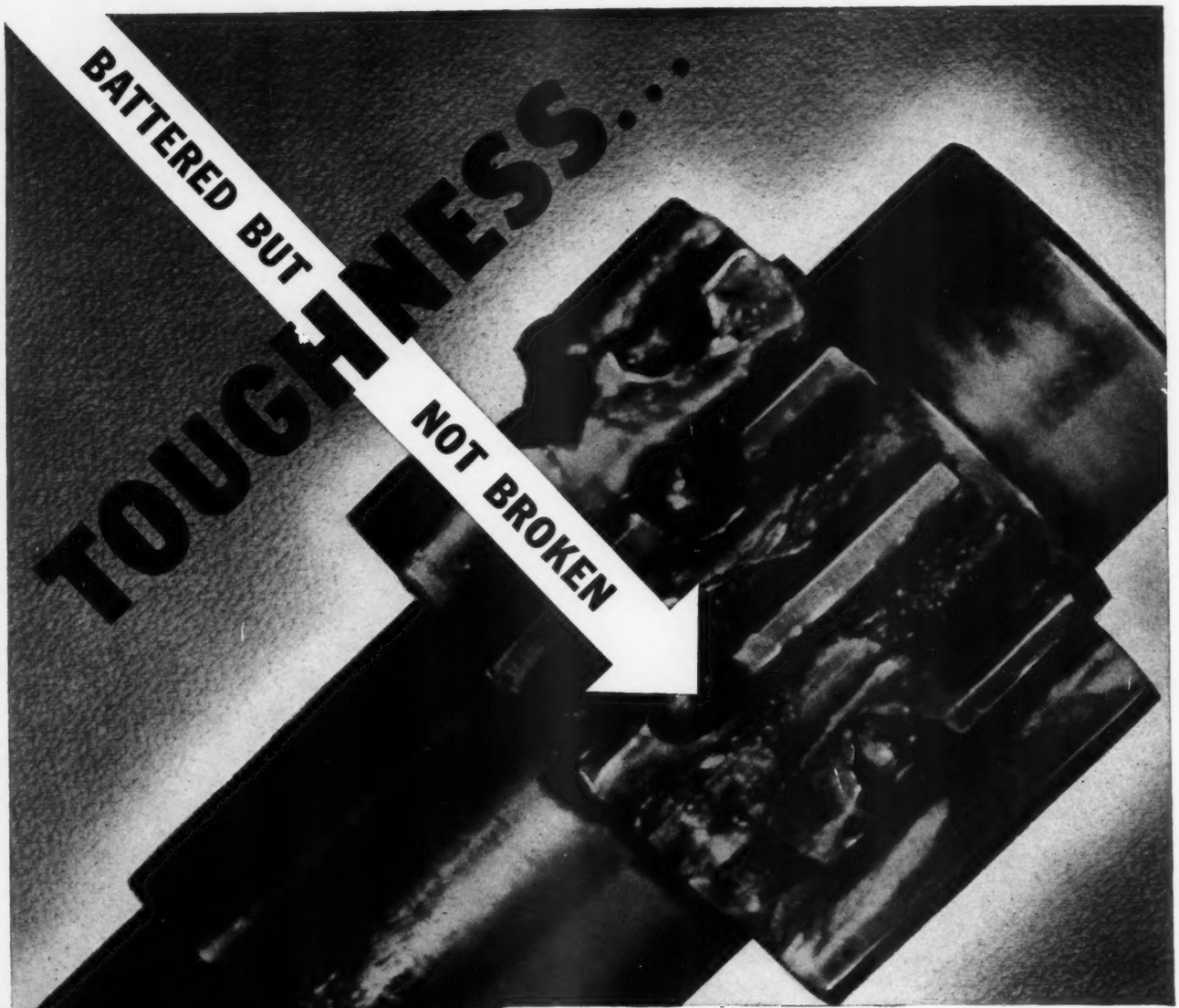


Featuring HIGH-SPEED CHAIN DRIVES



Twelve years ago engineers of Automatic Transportation Co., Chicago, specified SAE 3135 Nickel-toughened steel for pinions in their industrial trucks. After 12 years' service, this Nickel alloyed material retained ductility and toughness to deform rather than break when ball bearings fell into the teeth.

WHAT you need for dependable service — at lowest cost per year — is a tough material combining ample strength and hardness with unusually high ductility. A significant example of such a metal, which deforms rather than breaks, is this pinion pictured above. Balls from a shaft bearing of an industrial truck escaped from their race and fell into the teeth of this pinion gear.

After twelve years' service, this pinion — forged from heat treated SAE 3135 Nickel chromium steel — was still strong enough to stand up under crushing stress. Despite their ductility, these teeth proved too hard for redressing. Make sure of metals which will be strong and tough after twelve years' economical service. Specify Nickel alloyed materials for all vital parts which must resist stress and wear.

ALLOY NICKEL STEELS

THE INTERNATIONAL NICKEL COMPANY, INC., 67 WALL ST., NEW YORK, N. Y.

PRODUCT ENGINEERING

FEBRUARY, 1940

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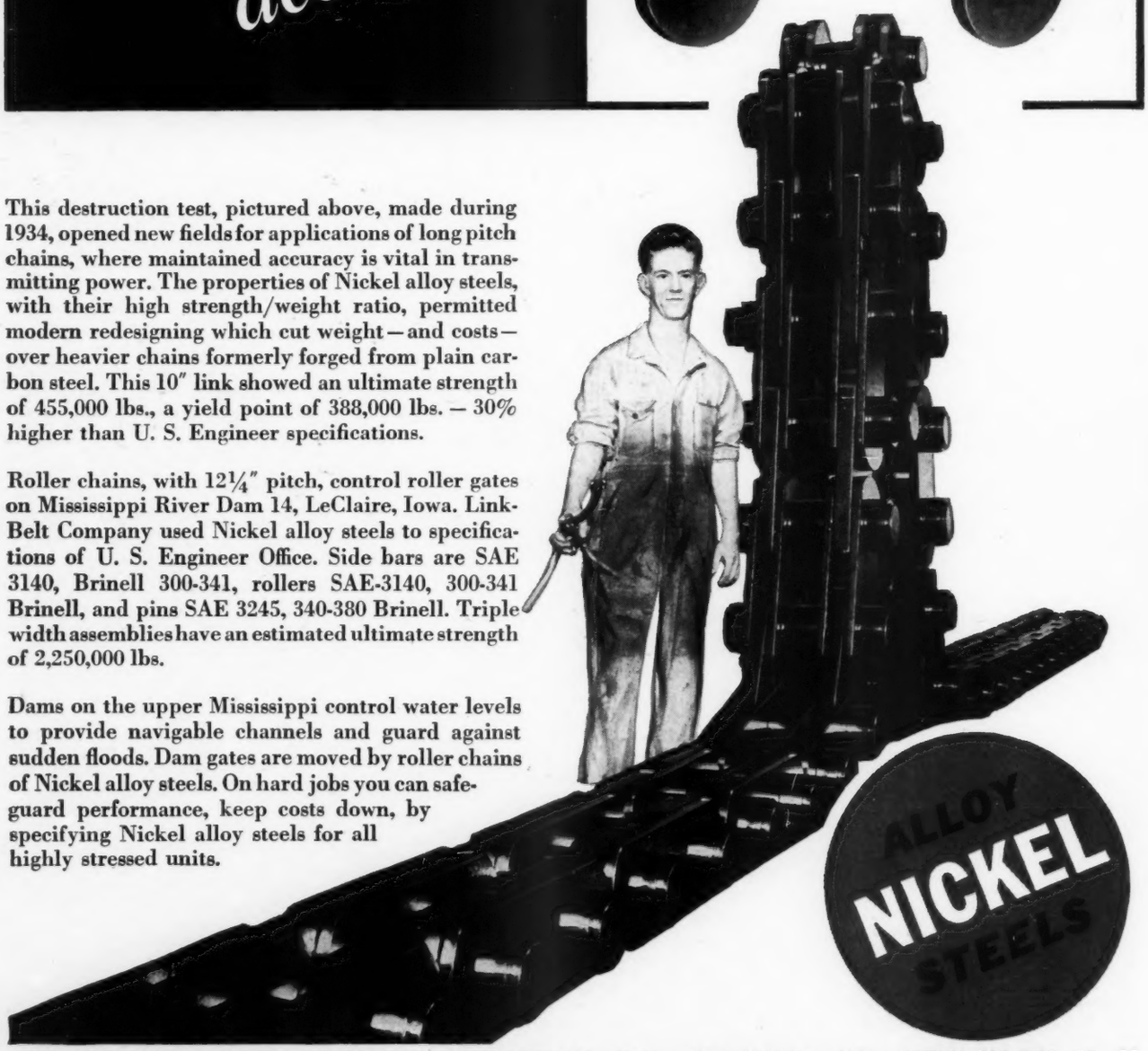
Featuring ROAD MACHINERY DESIGN

This test **CHANGED** *chain design*

This destruction test, pictured above, made during 1934, opened new fields for applications of long pitch chains, where maintained accuracy is vital in transmitting power. The properties of Nickel alloy steels, with their high strength/weight ratio, permitted modern redesigning which cut weight—and costs—over heavier chains formerly forged from plain carbon steel. This 10″ link showed an ultimate strength of 455,000 lbs., a yield point of 388,000 lbs. — 30% higher than U. S. Engineer specifications.

Roller chains, with 12¼″ pitch, control roller gates on Mississippi River Dam 14, LeClaire, Iowa. Link-Belt Company used Nickel alloy steels to specifications of U. S. Engineer Office. Side bars are SAE 3140, Brinell 300-341, rollers SAE-3140, 300-341 Brinell, and pins SAE 3245, 340-380 Brinell. Triple width assemblies have an estimated ultimate strength of 2,250,000 lbs.

Dams on the upper Mississippi control water levels to provide navigable channels and guard against sudden floods. Dam gates are moved by roller chains of Nickel alloy steels. On hard jobs you can safeguard performance, keep costs down, by specifying Nickel alloy steels for all highly stressed units.



ALLOY **NICKEL** STEELS

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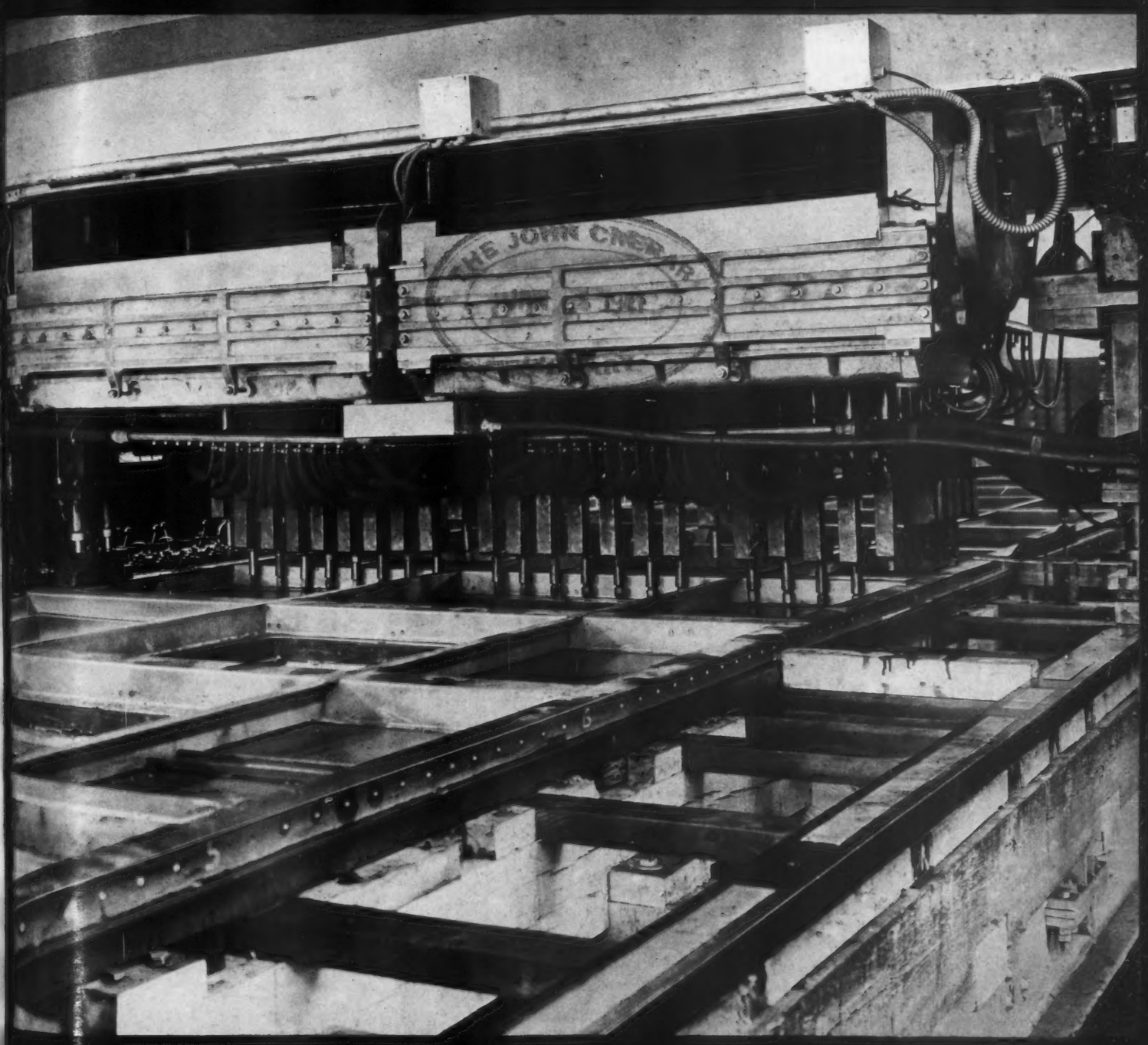
PRODUCT ENGINEERING

MARCH, 1940



The 62 electrode automatic machine spot welding a car side sheet to the arc welded frame, as described in "Designed for Welding"

Each one labelled to show strength and hardness...

CERTIFIED GEARS ★

...cast in NICKEL alloyed iron

DEPENDABILITY is all-important to the designing or specifying engineer when selecting a gear and no gear is more dependable than the material from which it is made.

Braun Certified Gears are dependable. Made of a Nickel-chromium-molybdenum cast iron each gear is tested, labelled and guaranteed to provide a minimum tensile strength of 50,000 p.s.i. High hardness controlled within narrow limits reduces abrasive wear, preserves tooth contours and assures longer service.

The improved properties of Nickel alloy cast irons enable Braun gears to more successfully withstand abnormal loadings and stresses. Furthermore the uniformly high strength of this material permits redesigning for smaller gears and more compact assemblies.

Consultation is invited on your problems involving Nickel.

Typical minimum properties of Nickel-chromium-molybdenum cast iron used by Braun Gear Corp.:

Minimum tensile strength, p.s.i.	50,000
Compression strength, p.s.i.	150,000
Shear strength, p.s.i.	58,000
Torsional strength, p.s.i.	67,000
Modulus of elasticity	20,000,000
Torsional modulus elasticity	7,500,000
Transverse strength, lbs.	3,000
Transverse deflection, in. (test bar 1.2" diameter, 18" span)	0.04
Brinell hardness	220
Weight per cubic inch, lbs.	0.26

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

PRODUCT ENGINEERING

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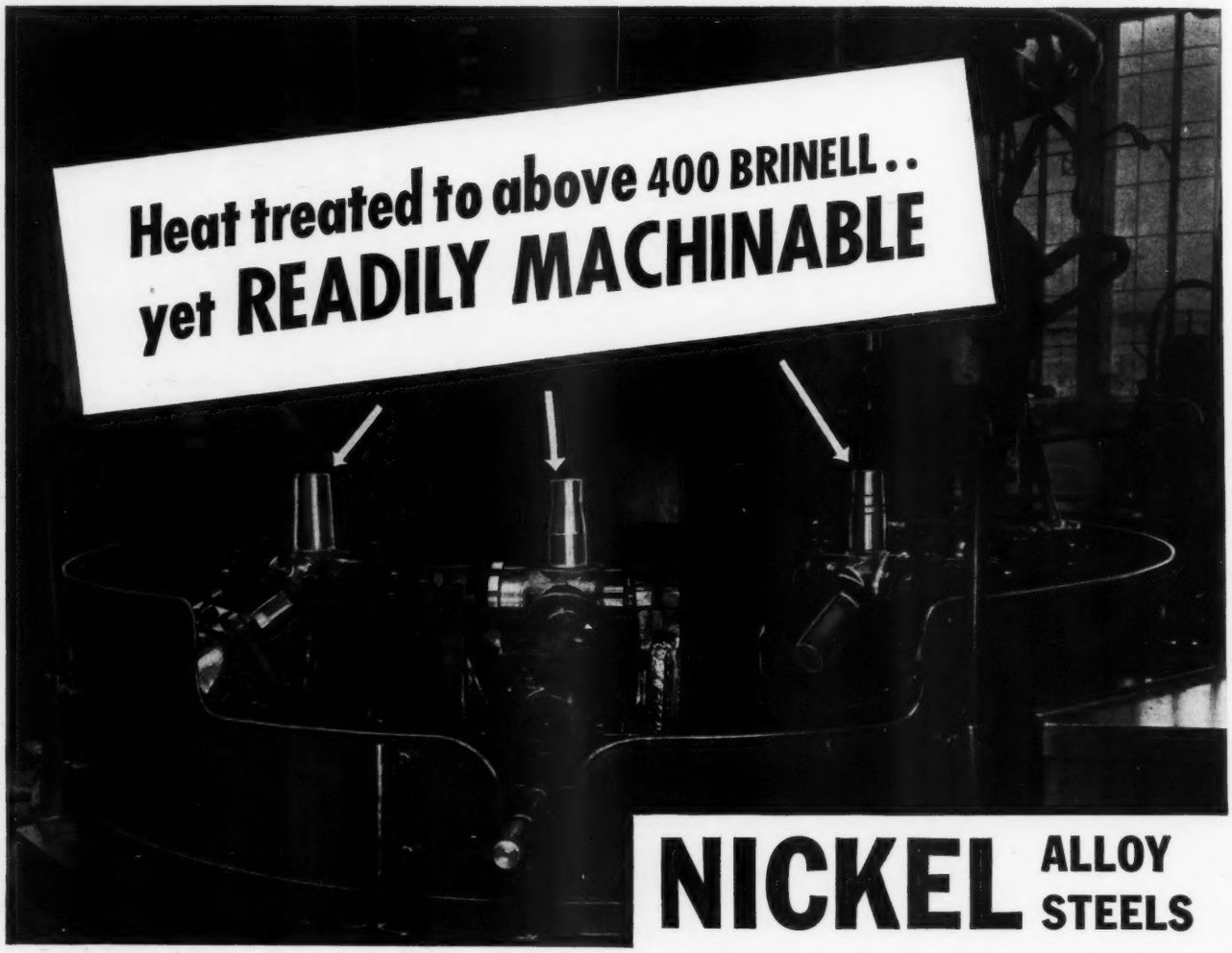
APRIL, 1940

Design OF MACHINERY *and* EQUIPMENT... METHODS · MATERIALS · PARTS



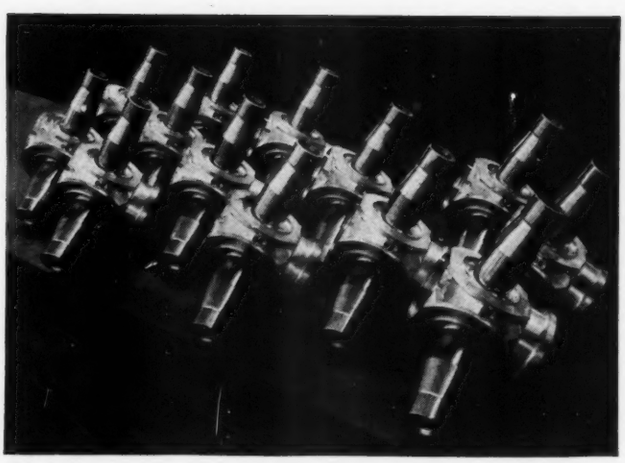
NICKEL ALLOY STEELS

For parts subject to high stresses in service, heat treatment *before* machining offers many advantages. Warpage and distortion frequently resulting from heat treatment after machining are minimized. In addition, points of stress concentration are avoided resulting in considerably greater life for the machined part when placed in service.

Especially interesting are present shop practices of airplane part and other mass production plants now machining heat treated Nickel alloy steels ranging in hardness up to 450 Brinell. *(above)* Stressed Hydromatic Propeller spiders of SAE 4340 heat treated to approximately 415 Brinell are machined with ease in the regular production line at the East Hartford, Conn. plant of Hamilton Standard Propellers, Division of United Aircraft Corp.

• • •

In a recent demonstration on a standard Warner & Swasey turret lathe conventional high speed tools readily turned, chamfered and drilled a 2″ bar of Nickel-chromium-molybdenum steel at a hardness of 450 Brinell. The turning cut was fed at .012″ at a speed of 42′ a minute. The close helical chip showed no tendency to tear, check or burn. The smooth surface produced indicates that machining Nickel alloy steels at high hardness is not unusually difficult.



Hamilton Standard Propellers, Division of United Aircraft Corp., East Hartford, Conn. regularly machine SAE 4340 stressed Hydromatic Propeller parts including spiders, illustrated here, and cams after they have been heat treated to approximately 415 Brinell. Hard Nickel alloy steels are no hazard where machining is concerned. For additional information please write to the address printed below:

THE INTERNATIONAL NICKEL COMPANY, INC.
67 WALL STREET
NEW YORK, N. Y.

PRODUCT ENGINEERING

MAY, 1940

Featuring GLASS FOR MECHANICAL PARTS

Simple precautions assure

SOUND WELDS

IN

NICKEL STEELS

PRODUCING pressure vessels to meet A. S. T. M. specifications, Black, Sivalls & Bryson, Oklahoma City, says, "Provided only that simple necessary precautions are used in fabricating, 2½% Nickel steel pressure vessels can be welded with complete success at the same speed as mild steel, with greatly improved strength, safety and durability in the completed structure." With Murex 2¼% Nickel Steel electrodes, smooth, sound welds are made in 2½" thick 2.00/2.75% Nickel low carbon plates used in fabricating 24' accumulators.

FACTS...*for the asking*

Preheating, stress relieving, tensile strengths, impact resistance, shop practices . . . these important facts about the weldability of Nickel steels are yours for the asking. Simply write for your copies of "Welding Nickel Steels" and "The Working of S. A. E. Nickel Alloy Steels." Consultation on problems involving the use of Nickel is invited.

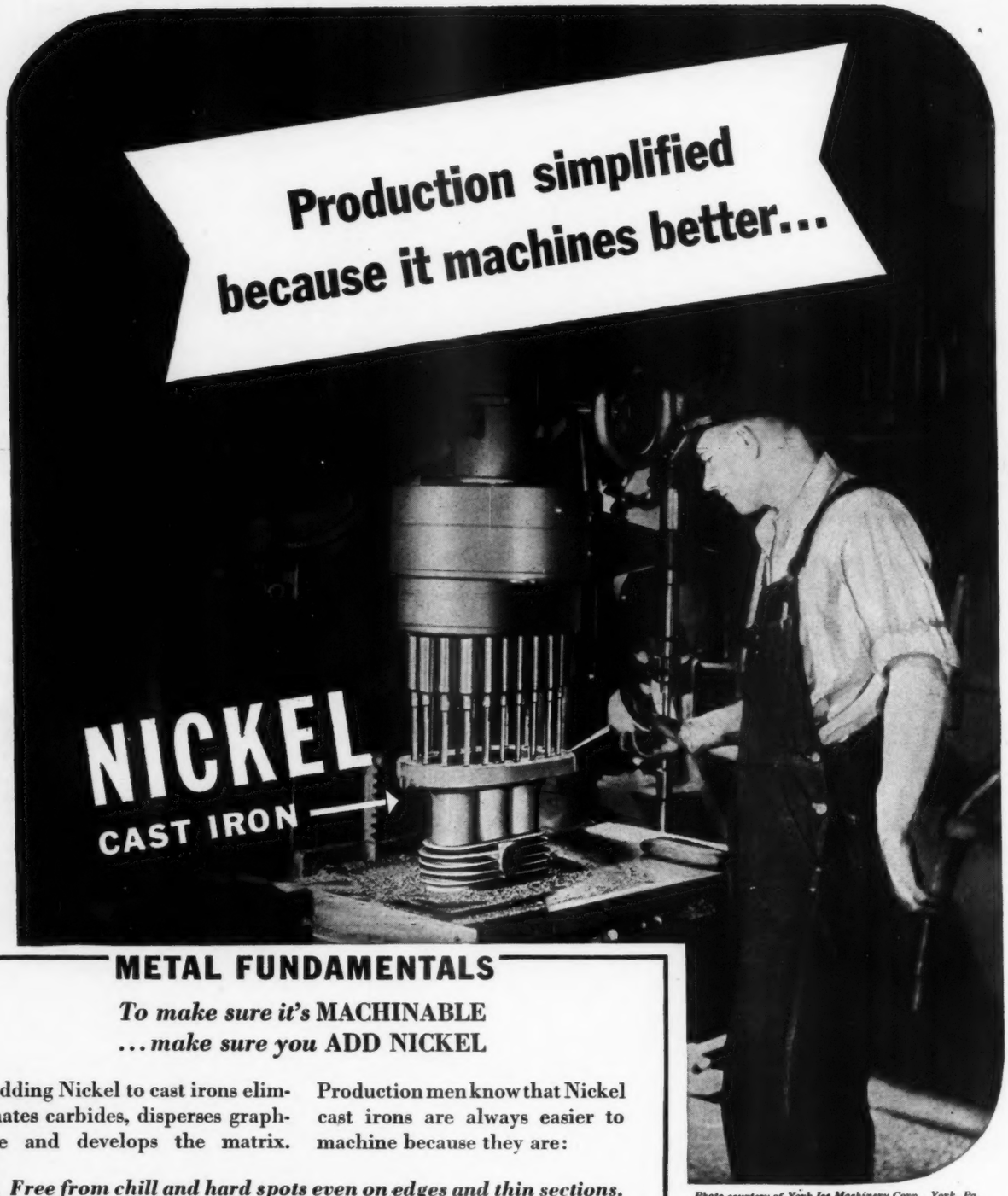
THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

PRODUCT ENGINEERING

JUNE, 1940

Design OF MACHINERY *and* EQUIPMENT... METHODS · MATERIALS · PARTS

Production simplified because it machines better...



METAL FUNDAMENTALS

To make sure it's MACHINABLE
... make sure you ADD NICKEL

Adding Nickel to cast irons eliminates carbides, disperses graphite and develops the matrix. Production men know that Nickel cast irons are always easier to machine because they are:

1 *Free from chill and hard spots even on edges and thin sections.*

2 *Free from porosity, shrinkage and open grain that cause costly rejects during and after machining.*

3 *Dependably uniform in hardness and structure through thick and thin sections.*

4 *Of maximum machinable hardness.*

5 *Fine grained permitting mirror-smooth finish.*

Photo courtesy of York Ice Machinery Corp., York, Pa.

Producing cylinder blocks or other castings with sections of varying thickness, a manufacturer's first thought is machinability. From long experience, he depends upon Nickel alone or in balanced combination. He knows Nickel added to cast iron assures improved machinability and uniformity of structure, plus higher strength and wear resistance in finished parts.

• • •

Your consultation on applications involving Nickel alloyed irons is invited.

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK, N. Y.

PRODUCT ENGINEERING

JULY, 1940

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Featuring VULCANIZED FIBRE — PROPERTIES AND WORKABILITY

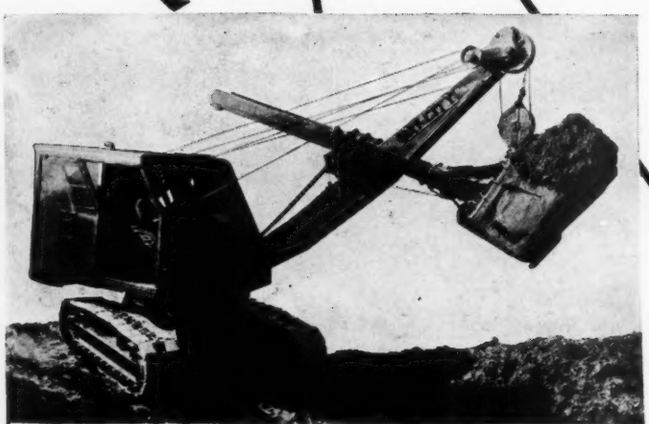
MORE STRENGTH TO MEET STRESS...

50 *places in a power shovel...*

85 *places in a rock drill...*

275 *places in a milling machine*

NICKEL ALLOY STEELS



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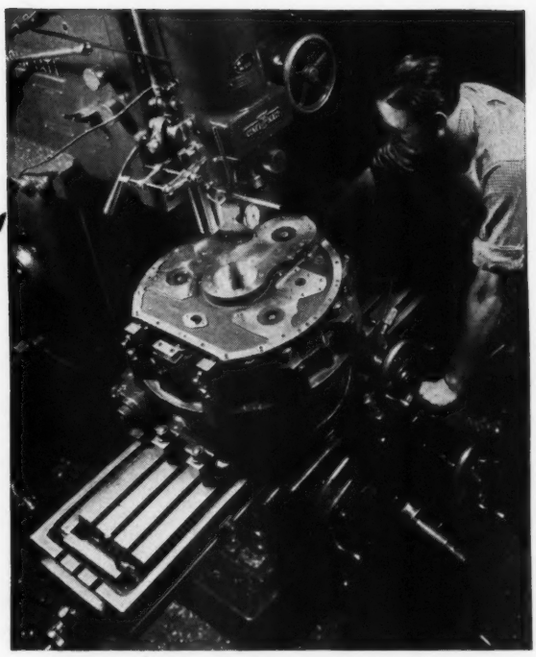

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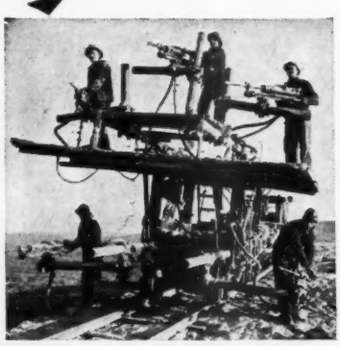

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• • •

➡ Purchasing and production are often simplified because the versatility of Nickel steels usually permits one Nickel steel to efficiently serve many purposes. Practical answers to your inquiries will be given promptly, based upon our broad experience with many industries. Please address:

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PRODUCT ENGINEERING

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AUGUST, 1940

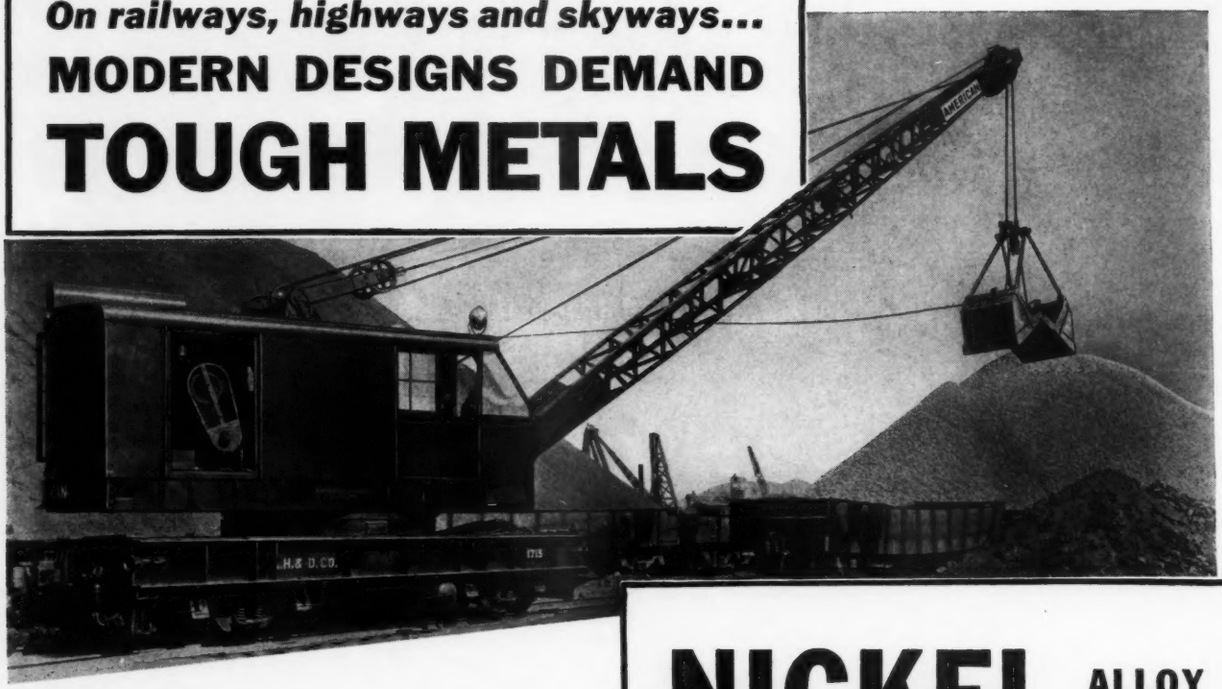
THE JOHN CRERAR
JAN 5 1941
LIBR

Featuring HIGH-SPEED PHOTOGRAPHY FOR DESIGN ANALYSIS

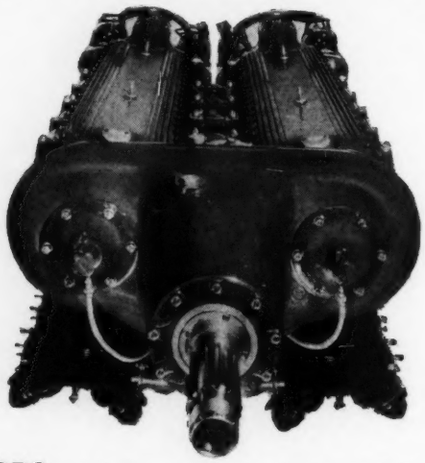
On railways, highways and skyways...

MODERN DESIGNS DEMAND

TOUGH METALS

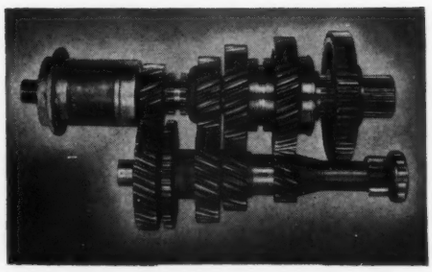


CRANES—Whether you build cranes, planes or truck transmissions, 1940 competition demands efficient, compact designs. Such designs are economically practical when you specify tough, long wearing Nickel alloy steels for stressed units. This modern locomotive crane manufactured by the American Hoist & Derrick Co., St. Paul, Minn., utilizes Nickel steels with tensile strengths up to 115,000 lbs. per square inch for stressed shafting, gears and pinions.



MOTORS—Airplane motors must not fail, so the Menasco Manufacturing Co., Los Angeles, Calif., assure dependability in their "Unitwin" motor by using tough, strong, long-serving Nickel alloy steels for all important parts. The new "Unitwin" consists of two separate in-line engines, generating 325 h.p. apiece, geared to drive a single propeller. The "Unitwin" is used in Vega six place "Starliner" planes.

NICKEL ALLOY STEELS



TRUCK TRANSMISSION PARTS

must withstand rough usage and abuse in service. Therefore, the manufacturers of the heavy duty transmission illustrated here, The Four Wheel Drive Auto Co., Clintonville, Wisconsin, specify Nickel alloy steels to assure safe extra strength and toughness in light weight stressed parts. This transmission is especially designed for heavy duty four-wheel drive service, having a torque capacity in excess of the largest engines available.

➡ Heat treatable, readily machinable steels containing Nickel may enable you to simplify design and speed up production. Our suggestions are based upon the practical experience of many plants. For information, without obligation, please address:

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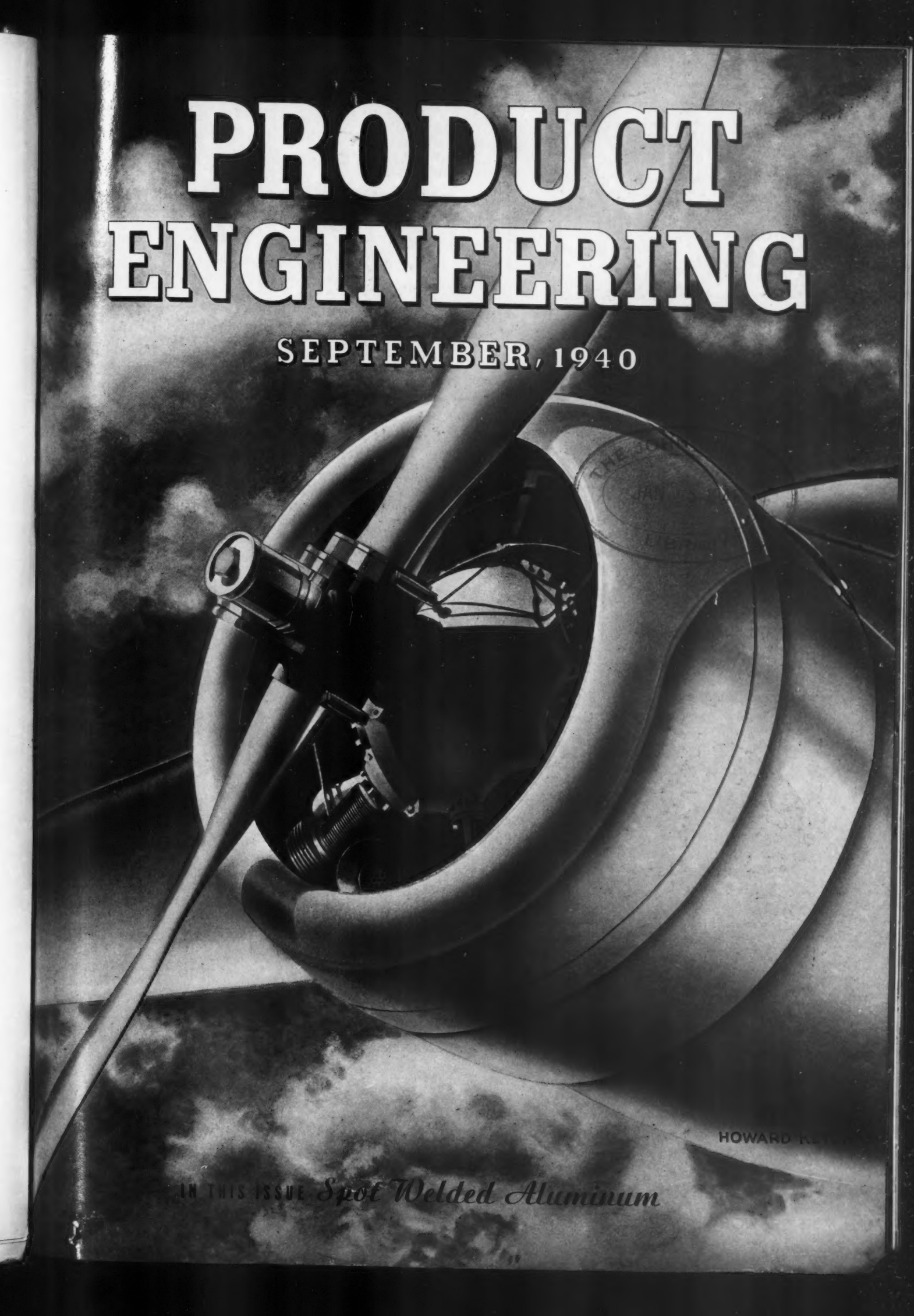
SEPTEMBER, 1940

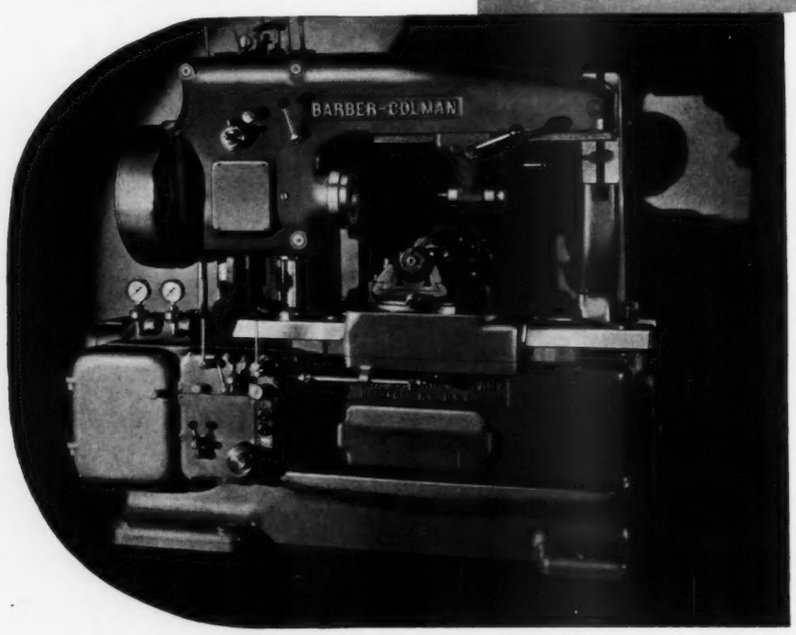


IN THIS ISSUE *Spot Welded Aluminum*

NICKEL
CAST IRONS

FOR GEARS THAT WEAR BETTER AND LAST LONGER

HIGH CARBON, Nickel alloy, electric furnace cast iron compositions recently developed by Frank Foundries, Moline, Ill., meet all basic requirements for improved gear materials including good strength, ready machinability and wear resistance. Pictured at right is a hobbing machine gear produced from one of these special Nickel-chromium-molybdenum cast irons whose tensile strength is in excess of 40,000 lbs. per square inch and whose Brinell Hardness is approximately 240 in 1.2″ sections. These alloy cast irons possess structural characteristics which assure a high degree of wear resistance combined with other properties essential to improved gear performance.



EFFECTIVE LUBRICATION in this Barber-Colman hydraulic hobbing machine is assured by a combination of good design and the selection of suitable materials. High carbon Nickel Cast iron gears are structurally designed to assist in full lubrication and accordingly to reduce gear wear and assure quiet and satisfactory operation of a unit. Adding Nickel to cast iron induces dense grain in gear castings and markedly increases their resistance to wear.

• • •

NEW GEAR BOOK— Write for your copy of our new publication "Modern Trends in Nickel Steel and Cast Iron Gear Materials". Available free on request.

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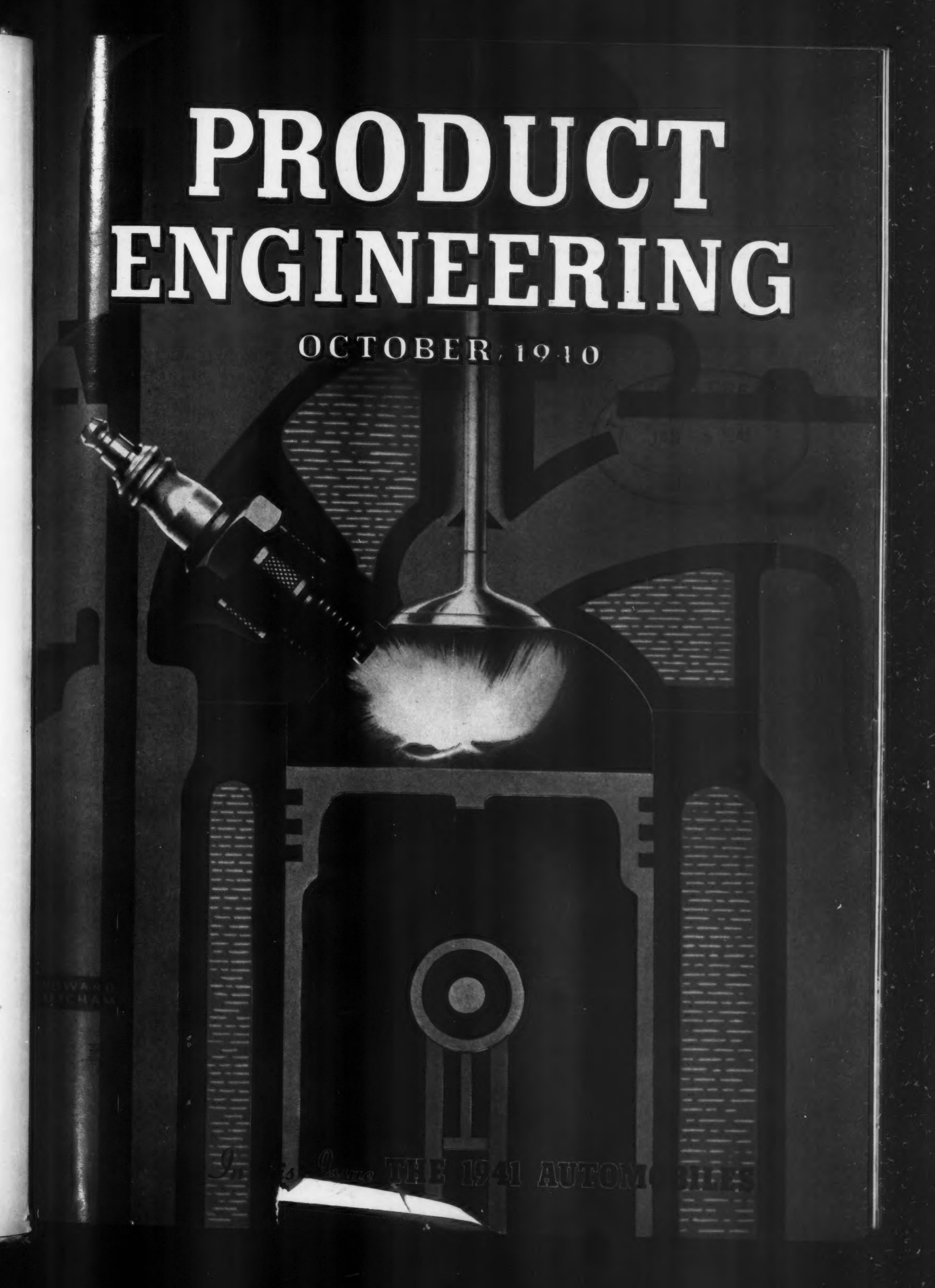
OCTOBER, 1940



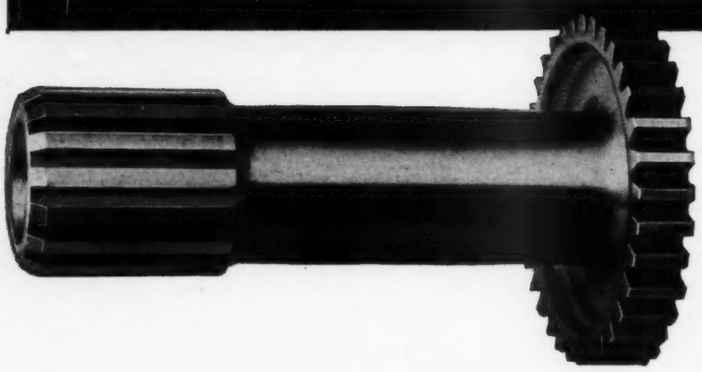
Adding NICKEL TO GEAR STEELS

1—IMPROVES *mechanical properties*
2—SIMPLIFIES *fabricating problems*

PERMISSIBLE COMPRESSIVE STRESSES ON ENGAGED GEAR TEETH

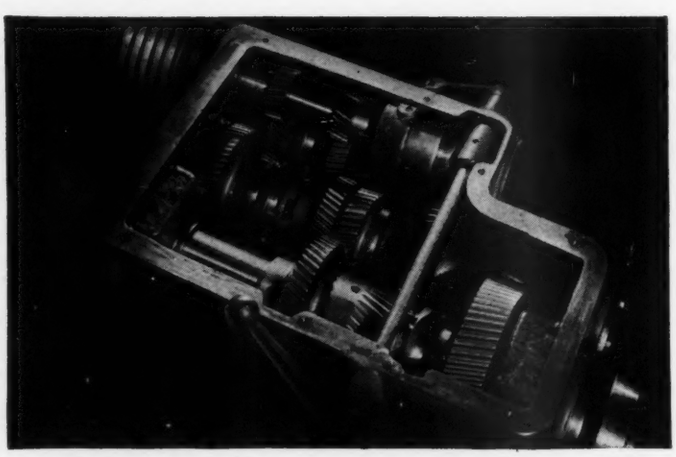
TYPE	NICKEL ALLOY STEELS S.A.E. Classification	PERMISSIBLE COMPRESSIVE STRESS*
Direct Hardening	3150, 4640, 4650, etc.	170,000 lb./sq. in.
Carburizing	3115, 3120	180,000 lb./sq. in.
Carburizing	2315, 2320, 4615, 4620	200,000 lb./sq. in.
Carburizing	3312, 4815, 4820, 2515	215,000 lb./sq. in.

*Compressive stresses calculated from Hertz formula. These values are for intermittently loaded gears and should be reduced 20/25% for constant mesh loading.



Choosing the most suitable gear steel depends upon getting mechanical properties to safely meet service requirements. But of equal importance are fabricating properties ...uniform response to heat treatment with minimum distortion and freedom from cracking, plus *economical machining.* Today's higher speeds and heavier tooth loadings emphasize the advantages of specifying direct hardening and carburizing gear steels alloyed with Nickel...Nickel alone or in combination.

Hollow quill shaft with integral gear and splines, pictured at left, must be resilient to absorb torque of 500 HP Ranger aircraft engine. To maintain tooth contours and resist fatigue stresses this vital shaft is forged from 3½% Nickel, 1½% chromium steel, SAE 3340.



Strong, tough and wear-resistant, headstock gears in Monarch lathes are 3½% Nickel steel, SAE 2350.

JUST PUBLISHED

"Modern Trends in Nickel Steel and Cast Iron Gear Materials," a paper presented before the American Gear Manufacturers Association 22nd semi-annual meeting. For your copy of this 16-page illustrated booklet, or for personal answers to your gear problems, please address:

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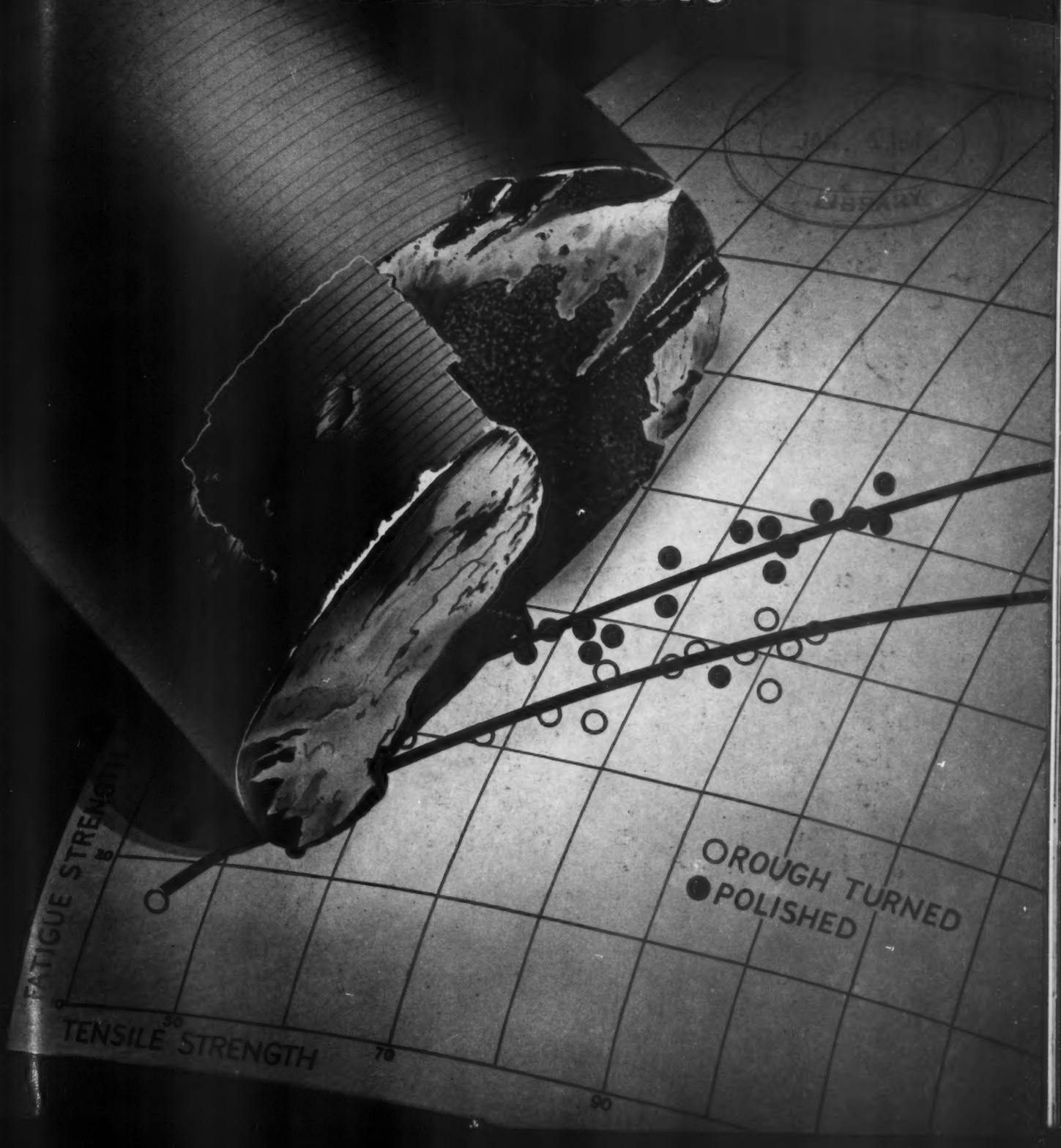
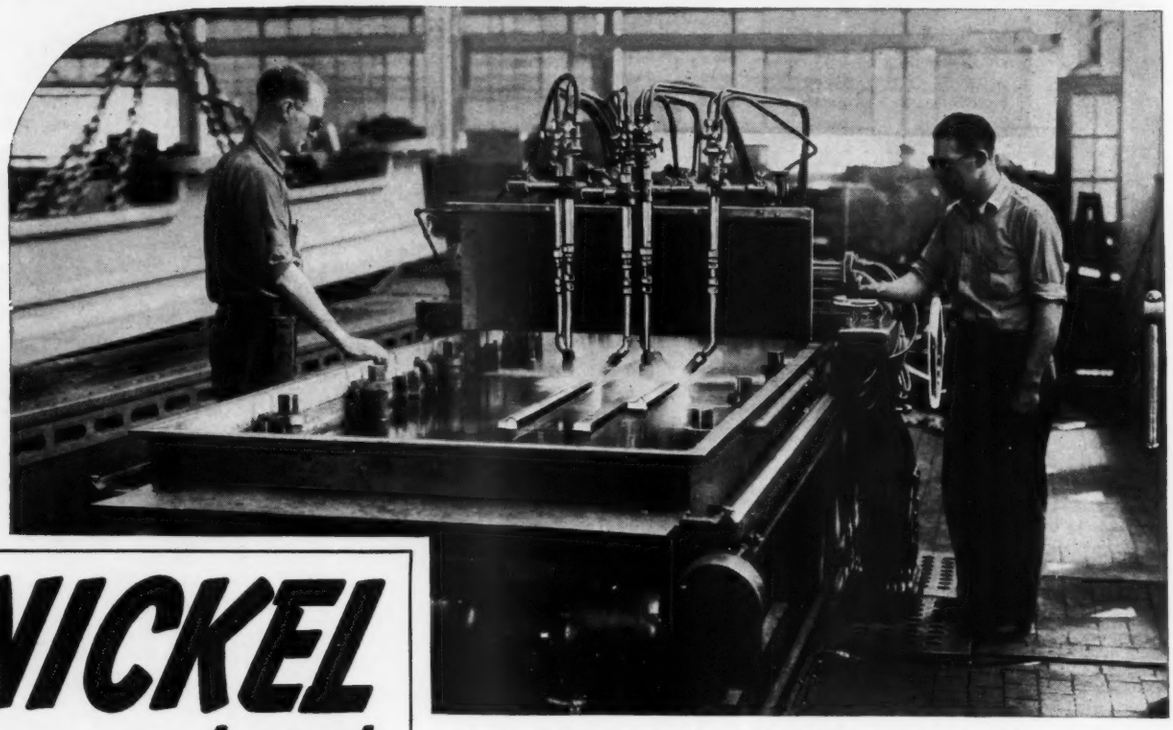
PRODUCT ENGINEERING

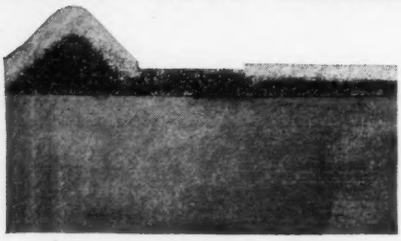
NOVEMBER, 1940



UNIFORMLY SUCCESSFUL FOR FLAME HARDENING

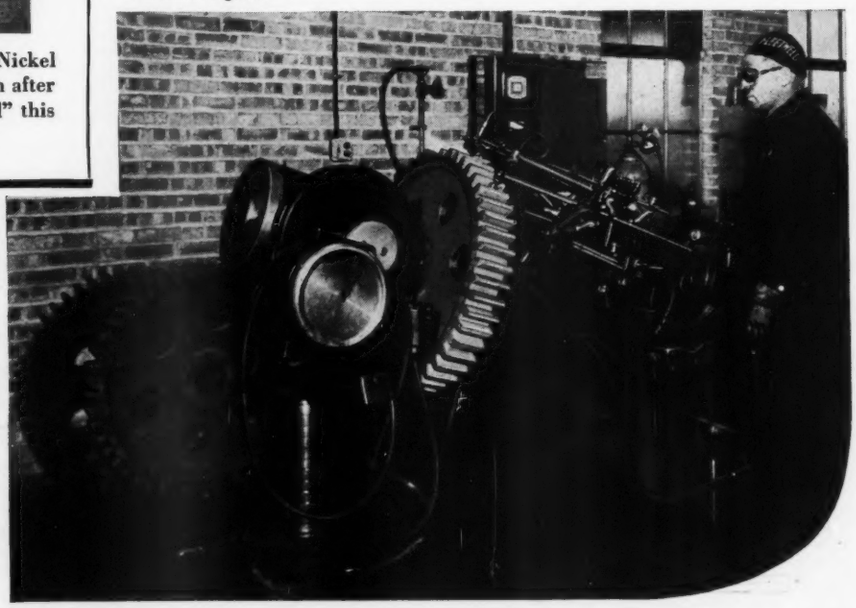


NICKEL
irons and steels



A BROKEN cross-section of a Monarch Nickel cast iron lathe bed shows ⅛" penetration after flame hardening. Nickel tends to "blend" this hardened surface into the core.

NICKEL additions to cast iron tend to condition the metal for flame hardening operations. Here the Monarch Machine Tool Co., Sidney, Ohio, is flame hardening ways used on Monarch lathes. Travelling at 3" to 6" per minute, oxy-acetylene jets pass only once to raise the surface Brinell hardness of this Nickel cast iron from 225/240 to 450/460. Average composition is Total Carbon 3.00, Silicon 1.70, Manganese 0.85, Nickel 1.50, Chromium 0.30%. Monarch states "The use of a carefully controlled nickel alloy cast iron can be depended on to eliminate hard spots and also to stabilize that portion of the carbide in the pearlitic matrix necessary for flame hardening to the fullest degree."



NICKEL alloy steels are especially well adaptable for flame hardening. Photo shows Wesley Steel Treating Co., Milwaukee, simultaneously flame hardening both faces of teeth on a large gear. Cam segments of SAE 3150 Nickel-chromium steel are flame hardened by Wesley to 580 Brinell. For detailed information about Nickel alloyed materials particularly suited for modern heat treating methods, please write to the address below.

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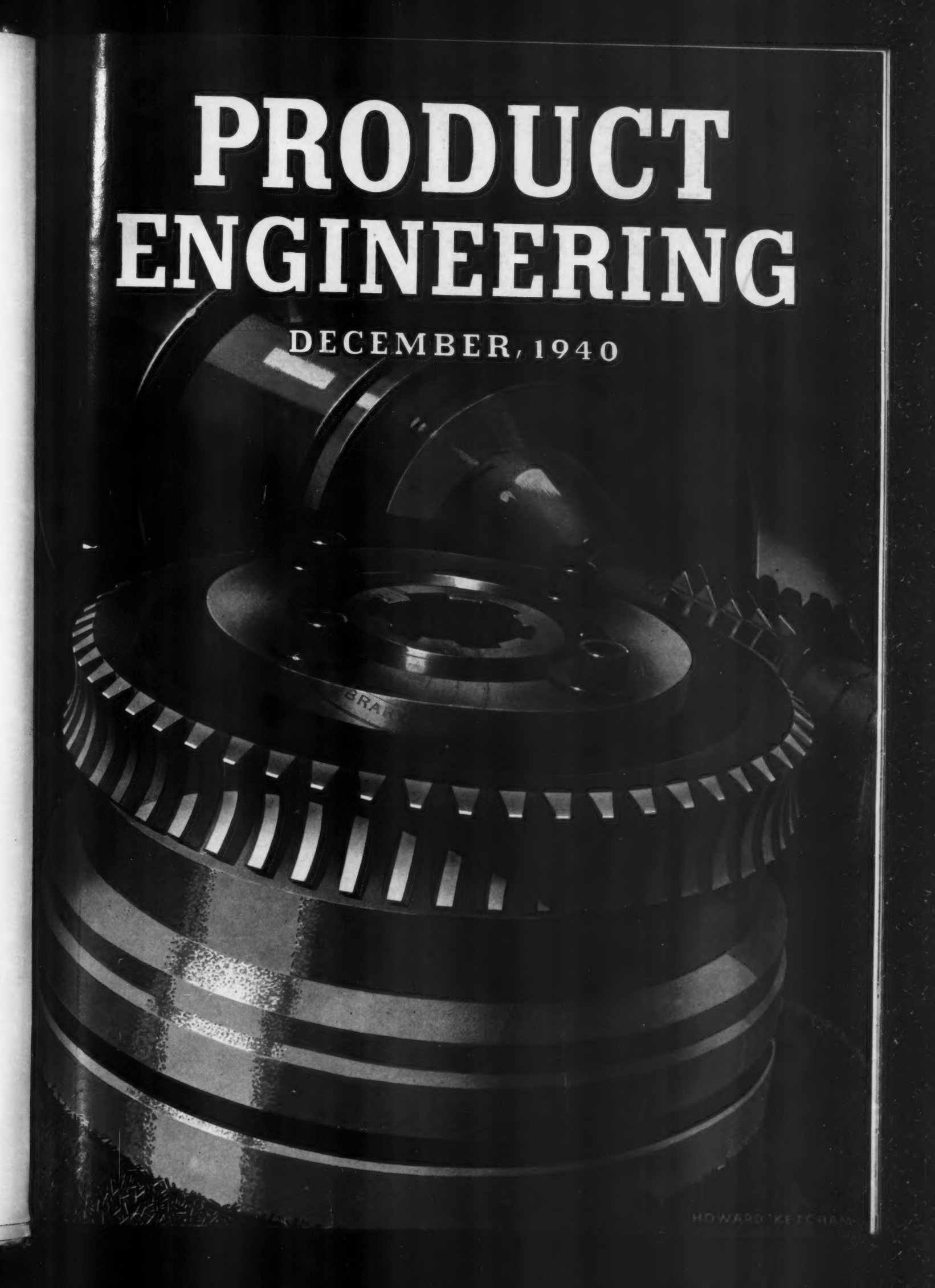
DECEMBER, 1940



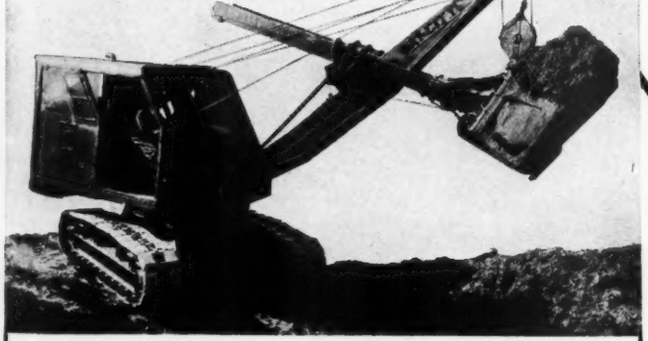
MORE STRENGTH TO MEET STRESS...

50 *places in a power shovel...*

85 *places in a rock drill...*

275 *places in a milling machine*

NICKEL ALLOY STEELS



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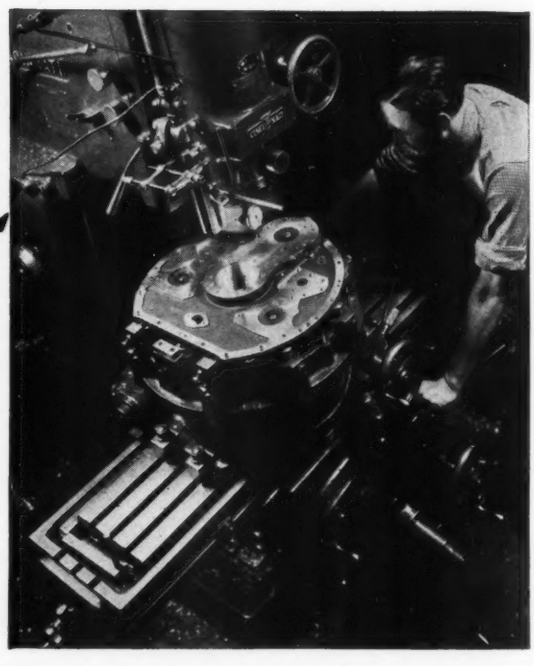

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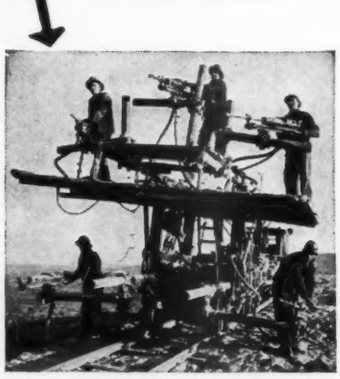

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PRODUCT ENGINEERING

What's Coming—

Automobile "fluid drives," or hydraulic couplings, have aroused a great deal of interest. What are the possibilities in the application of hydraulic couplings to machinery drives? What might be the advantages? What are the limitations? What factors must be considered? What are the different types of hydraulic couplings? What is their principle of operation? Mr. R. D. McCausland of the American Blower Corporation gives the answers to all these and other questions in the January number of P.E.

Over the past years, a great deal of research has been done on brake lining materials and brake design. Beginning with the January number, P.E. will present a series of articles that give in detail the latest developments in brake lining materials and their characteristics, factors in the selection of the type of lining, details of the design of brakes, brake drum materials and operating linkages.

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April 30, 1940

Product Engineering
330 West 42nd Street
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Attention: Mr. W. E. Kennedy

Gentlemen:

This is in reply to your letter of April 24 in which you inquire as to what extent we use the advertising section of "Product Engineering".

Will say that we frequently consult this section, and find it very useful. In addition, articles in this magazine are of great benefit to us, and we receive considerable valuable information from same.

Very sincerely yours,

KILLEFER MANUFACTURING CORPORATION

T. M. Thomas

Engineering Department

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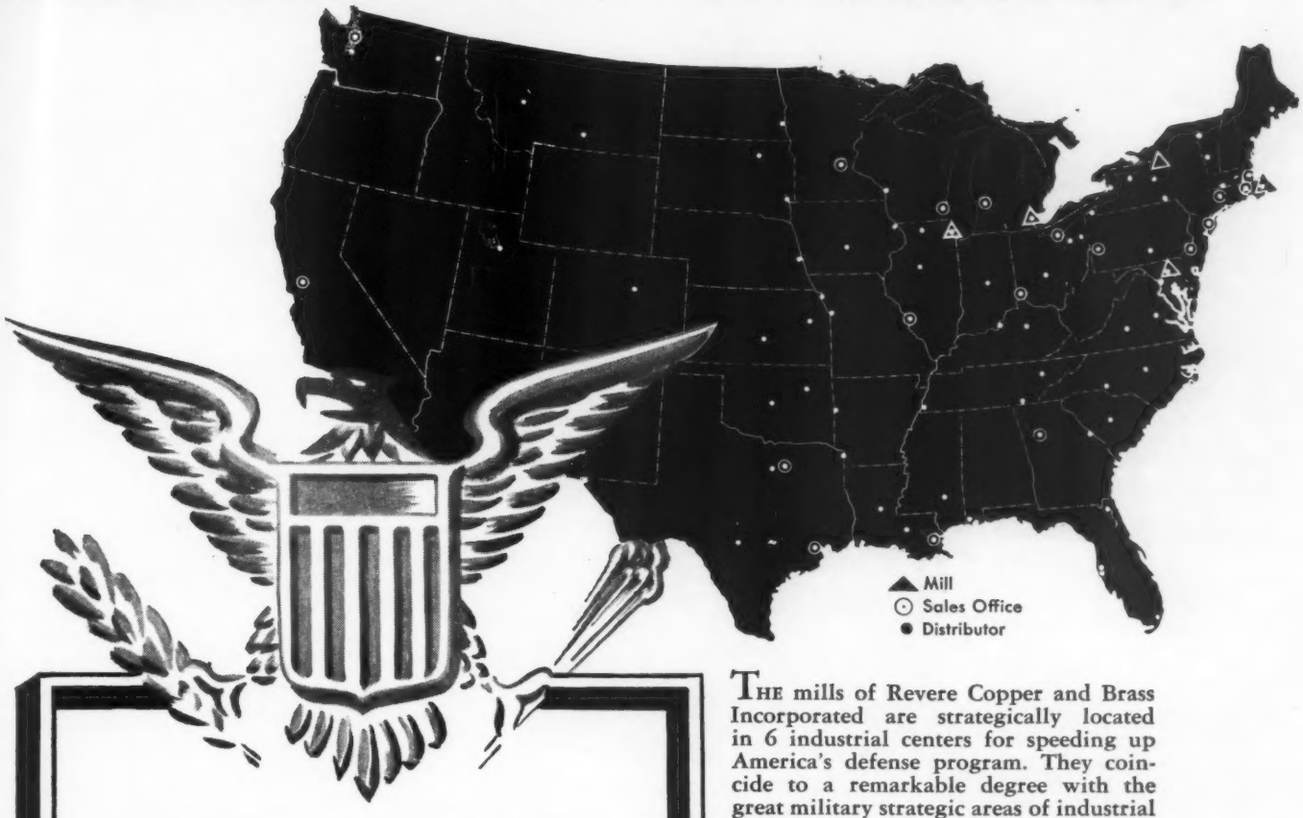
STRATEGIC POSTS FOR INDUSTRY



REVERE TECHNICAL ADVISORY SERVICE

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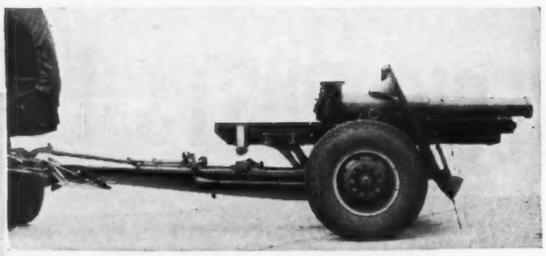
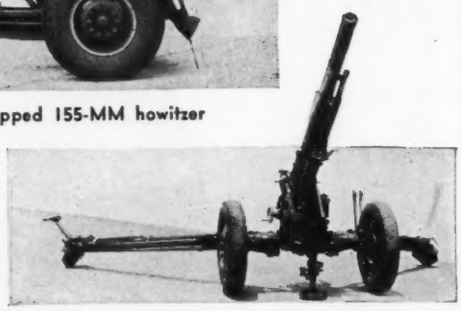
Timken Bearing Equipped 155-MM gun.



Timken Bearing Equipped 155-MM howitzer



Timken Bearing Equipped 75-MM field gun.

For Defense

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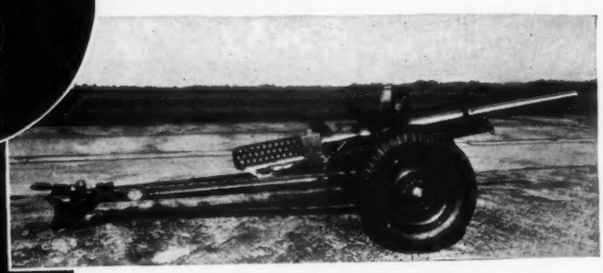
THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

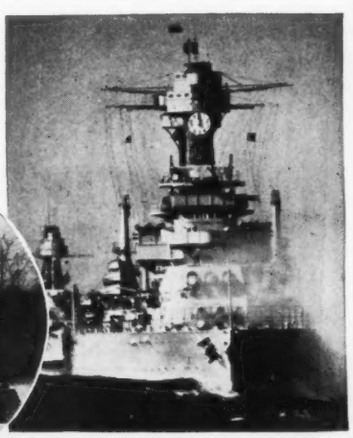


Timken Bearing Equipped 37-MM gun.

Timken Bearing Equipped light tank. →

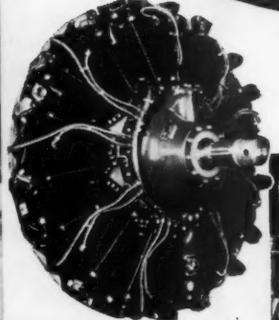
Timken Bearing Equipped 4-ton truck. ↓

Timken Bearing Equipped 1½-ton truck. ↓

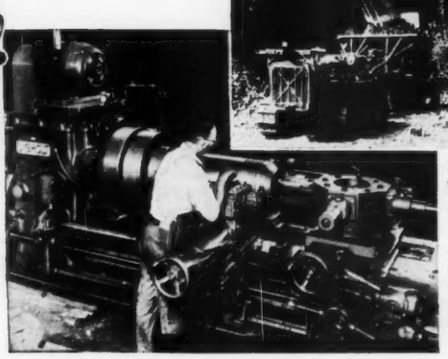


The U. S. Navy uses Timken Bearings in many kinds of equipment afloat and ashore.

U. S. military airplanes take off and land on Timken Bearing Equipped wheels.

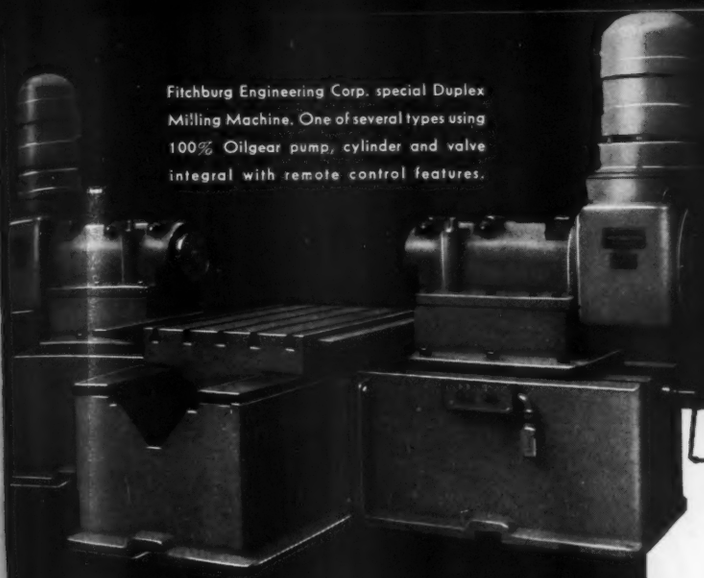


Power for U. S. war birds—Timken Bearing Equipped engines.

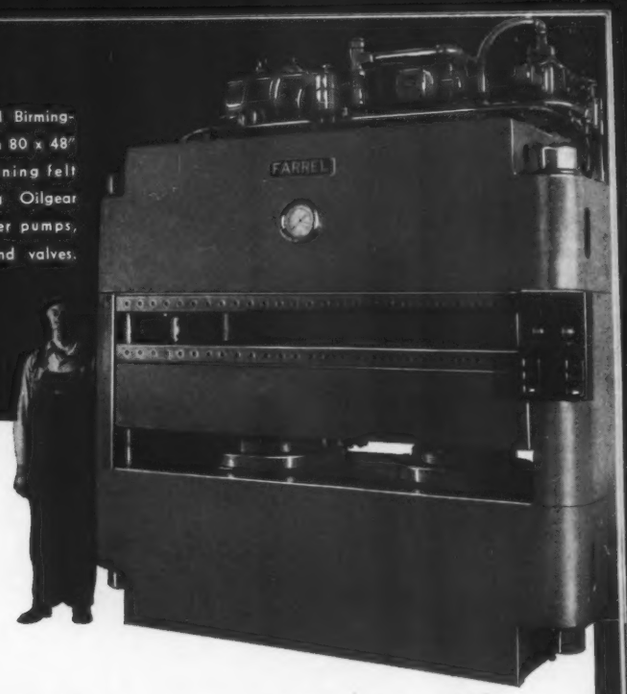


U. S. Army Engineers use a wide variety of Timken Bearing Equipped machines.

Millions of dollars worth of Timken Bearing Equipped precision machine tools will speed up our vast defense program.



Fitchburg Engineering Corp. special Duplex Milling Machine. One of several types using 100% Oilgear pump, cylinder and valve integral with remote control features.



Right: Farrel Birmingham 226-ton 80 x 48" single opening felt press, using Oilgear Fluid Power pumps, cylinders and valves.

There is no time for "*Time Out*" these days

Today, as never before, it is essential that production machines go right into production and *stay* in production. Busy factories have no time for "Time Out." Machine tool and machinery manufacturers themselves can't afford service complaints.

And so, machine tool and machinery manufacturers insist on having 100% Oilgear Fluid Power Equipment. They know a hydraulic system can be only as good as the pump and the cylinder and the valves. They know that all of Oilgear's unequalled experience in hydraulics goes into the design and construction of all of Oilgear Equipment. And they know that "100% Oilgear Equipped" is the strongest assurance of service they can offer their customers. Unequalled advantages result from this undivided responsibility which rests on Oilgear's leadership and fluid power achievements.

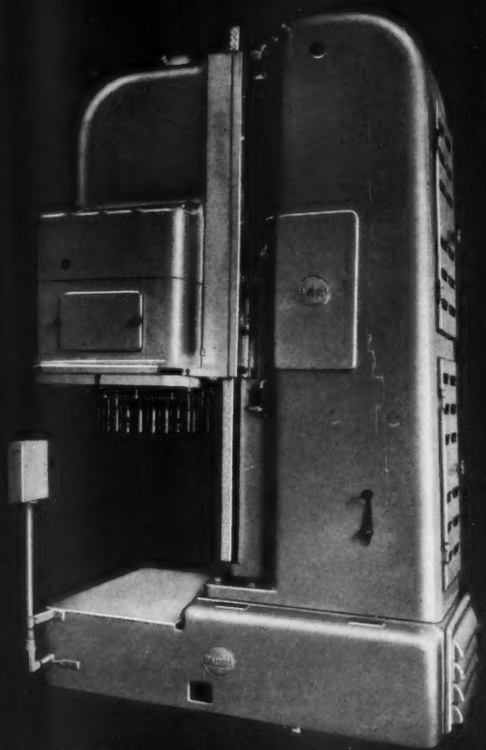
From a broad line of standard Fluid Power Equipment, Oilgear Engineers bring you "tailored to order" results that realize every objective you have in mind . . . a system that is simple to connect, operate and inspect. Oilgear *solutions protect machine manufacturers and users from every standpoint.* The urgency of the times calls for *dependable* Oilgear Fluid Power systems. Write for completely descriptive literature. THE OILGEAR COMPANY, 1311 W. Bruce Street, Milwaukee, Wisconsin.

OILGEAR

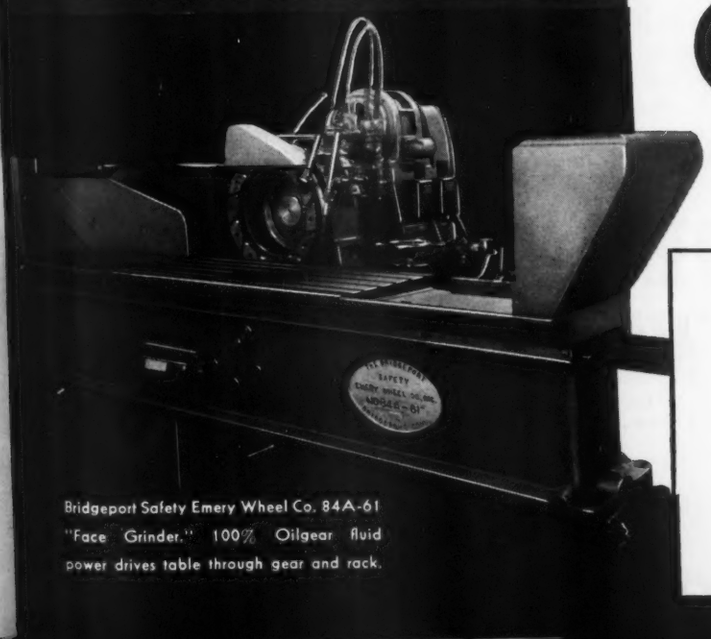
Trademark Reg. U. S. Pat. Off.

FLUID POWER

Feeds • Pumps • Cylinders • Valves • Motors • Transmissions • Horizontal and Vertical Broaching Machines • Horizontal and Vertical Presses • Custom Built Machines



Baush Machine Tool Co. Multiple Spindle Drilling and Tapping Machine 100% Oilgear equipped. Said to be the first hydraulic combination machine.



Bridgeport Safety Emery Wheel Co. 84A-61 "Face Grinder." 100% Oilgear fluid power drives table through gear and rack.

OILGEAR

THE MOST EFFECTIVE APPLICATION OF *fluid power*

THE OILGEAR COMPANY, 1311 W. Bruce Street, Milwaukee, Wis.

Please send me a copy of Bulletin 47000 without obligation.

Name.....

Company.....

Address.....

City.....*State*.....

A Veeder-Root Counter or Computing Device has given a sales lift to many products. For built-in Veeder-Root Devices add utility to machines. They make them more readily acceptable—easier to sell.

In the industrial field alone . . . where top efficiency is now the prime factor . . . buyers of equipment insist on machines with built-in "tell all" counters that give accurate, on-the-spot production records.

The same applies in other specific industries. Manufacturers of gasoline pumps are cashing in on the Veeder-Root "Head-for-figures" that computes sales. Manufacturers of parking meters, voting machines, tractors, typewriters, textile looms and many others are doing the same . . . all with Veeder-Root Counting and Computing Devices.

See what Veeder-Root Engineers can do for you. Write for free booklet showing some past outstanding achievements. No obligation.

VEEDER-ROOT Inc.

HARTFORD, CONNECTICUT, U. S. A.

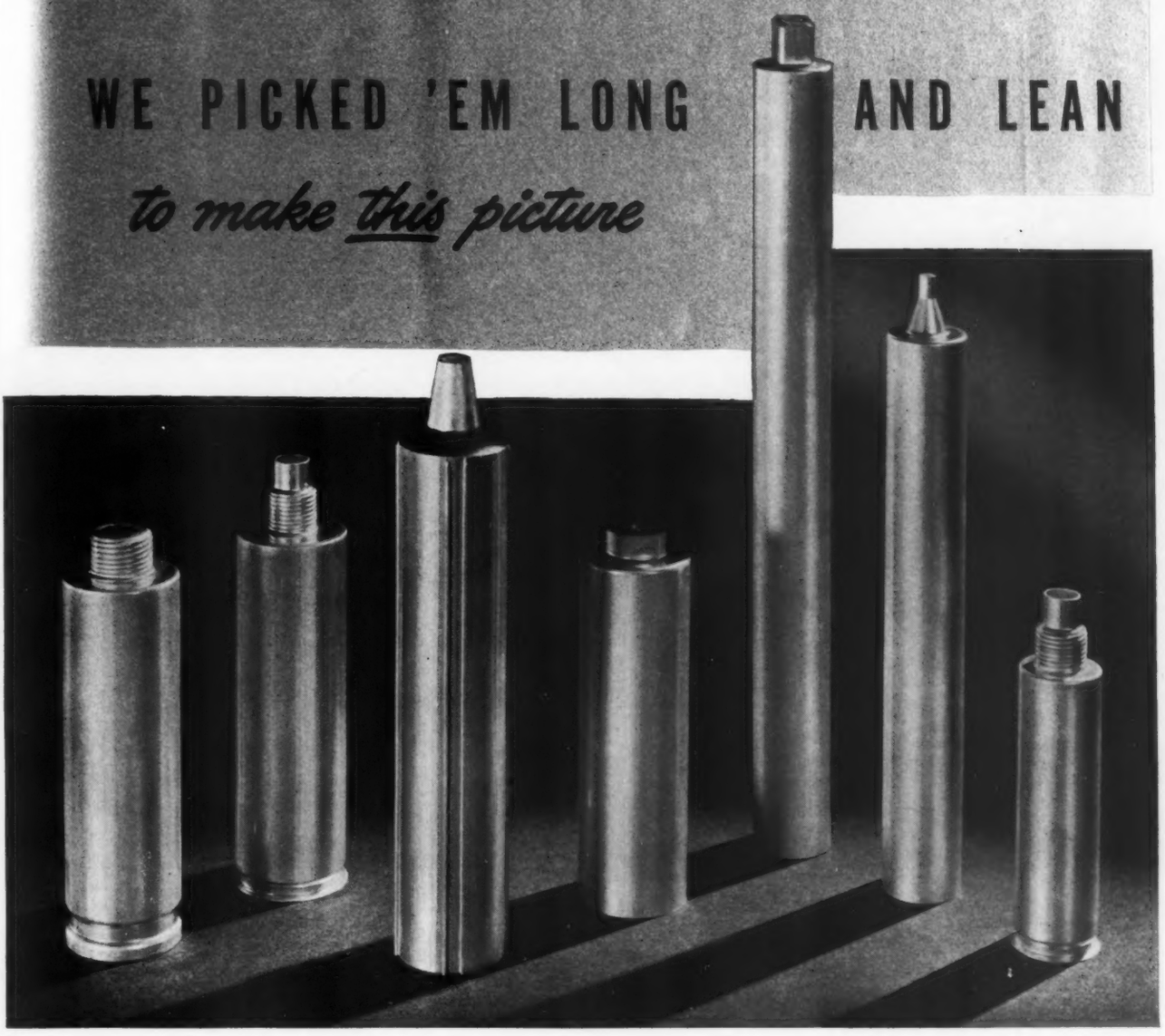
OFFICES IN Boston, Chicago, Cincinnati, Cleveland, Detroit, Greenville, S. C., Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Montreal, Buenos Aires, Mexico City, London, Paris, Tokio, Shanghai, Melbourne

IN ENGLAND: Veeder-Root Ltd., Croydon, Surrey

IN CANADA: Veeder-Root of Canada, Ltd., Montreal

WE PICKED 'EM LONG AND LEAN

to make this picture



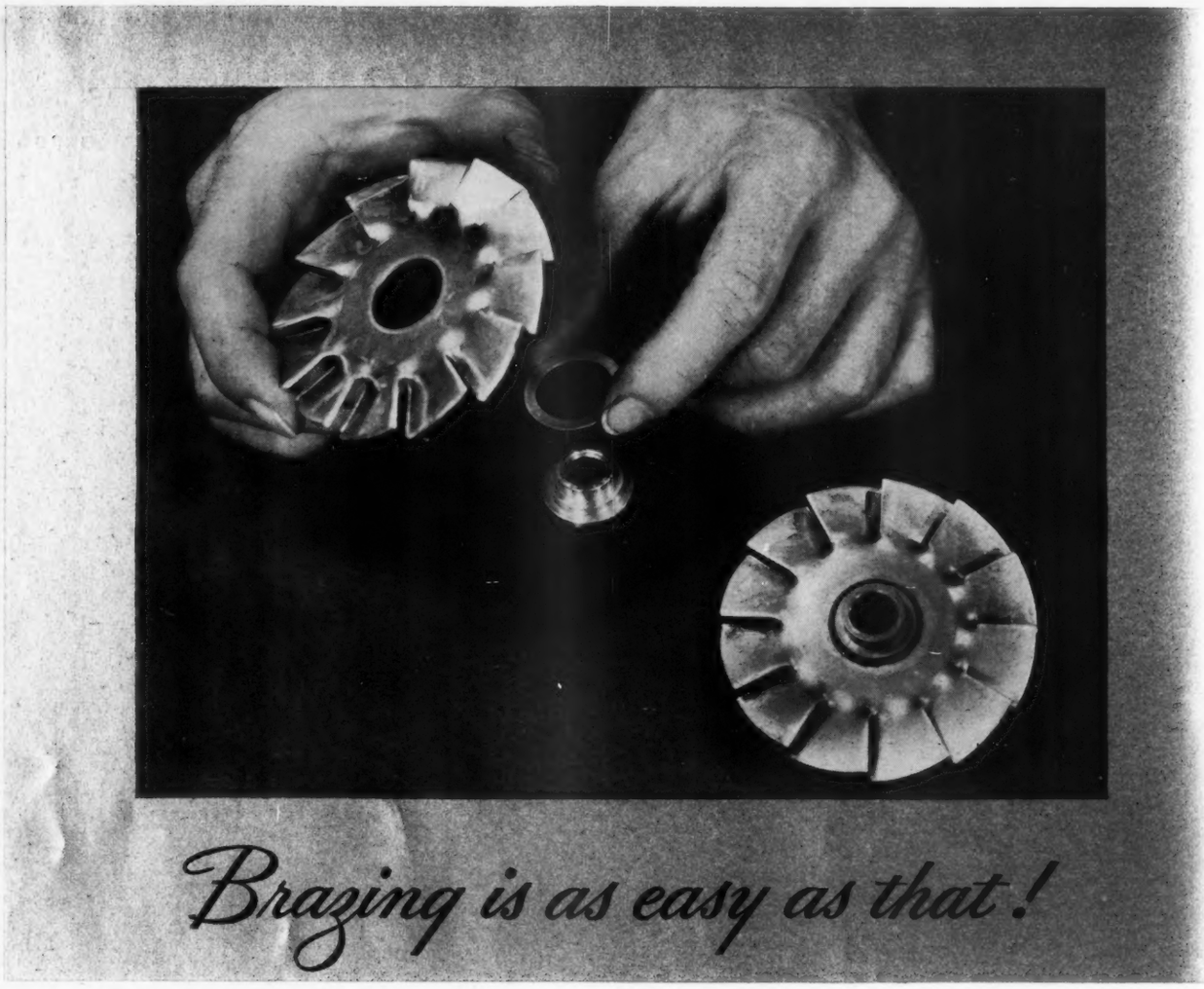
The streamlined similarity of these Alcoa Aluminum impact extrusions brought them together for this "family" portrait. Normally, they're total strangers, for they go into products of a number of manufacturers, but they have many things in common.

Alcoa impact extrusions are produced, in remarkably complete form, with a single wallop of the press. Often, only a few simple steps are needed to complete them; trimming, cutting threads, upsetting or spinning. The process is high speed, low cost production at its best.

Tolerances are close, with Alcoa impact extrusions. The metal is uniform and dependable, and mechanical properties are good. Walls can be thinner than bottoms and, on certain types, walls can be ribbed. Parts can be quite complicated, so many assembly and finishing operations are eliminated. ALUMINUM COMPANY OF AMERICA, 2193 Gulf Building, Pittsburgh, Pennsylvania.

IT IS NEVER COSTLY TO USE ALCOA ALUMINUM RIGHT

ALCOA ALUMINUM



Brazing is as easy as that!

A wipe of flux across each piece, the ring of brazing alloy between the hub and fan, then into the furnace for a few minutes; assembly of this Black & Decker portable tool ventilating fan is as simple as that!

Perhaps you were one of the hundreds who saw this process demonstrated at the Metal Show in Cleveland. Marveled with the others at its simplicity. Saw it as an aid to plants pushed for production. Realized the savings possible where this process is applicable.

Did you also know that, in quenching this piece as it comes from the brazing furnace, the full strength of this Alcoa Aluminum Alloy is developed? The combination of high strength, accurate balance and a two-thirds weight reduction, obtained in this Aluminum fan, helps Black & Decker produce smoother running, longer-lived tools.

ALUMINUM COMPANY OF AMERICA, 2193 Gulf Building, Pittsburgh, Pennsylvania.

IT IS THRIFTY TO USE ALCOA ALUMINUM WISELY

ALCOA ALUMINUM

3-WAY VALVES THAT *"fill the bill"* IN EVERY WAY

Press-forged valve bodies made for Parker Appliance Company.

The valves to be made from these blanks must be light in weight, pressure-tight and resistant to corrosion. Since the blanks were forged from an Aluminum Alloy, the valves will easily meet all three specifications. Alcoa press and hammer forgings have dense metal structure. They are uniformly sound and strong.

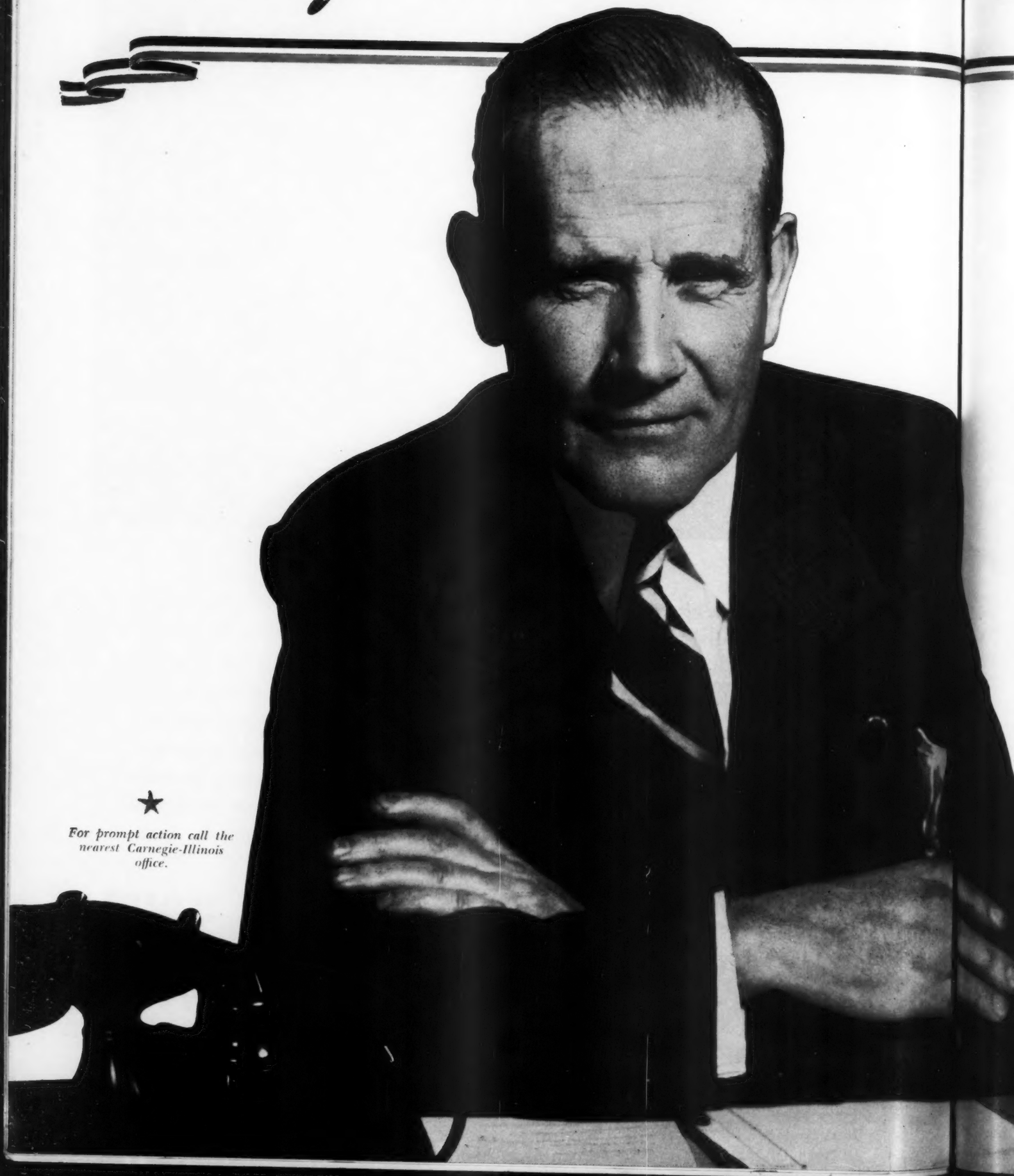
These valves will have the same long life and freedom from harmful action as the Aluminum processing equipment with which they are used.

Alcoa Aluminum press forgings often make it possible to show sizable savings in manufacturing costs. Shapes can be quite complicated and they are held to close dimensional tolerances. Small design detail and lettering can be accurately reproduced. Fewer finishing and assembly operations are required. ALUMINUM COMPANY OF AMERICA, 2193 Gulf Building, Pittsburgh, Pennsylvania.

IT IS THRIFTY TO USE ALCOA ALUMINUM WISELY

ALCOA ALUMINUM

Why do it the



★

For prompt action call the nearest Carnegie-Illinois office.

Hard Way ?

★★ If your part in the preparedness program involves new problems in the selection and working of steels . . . *use this service*

IF you are being asked to turn from familiar peacetime manufacturing and throw your best efforts into the production of materials for national defense you have no time for trial-and-error methods. Speed is the vital element.

What you want to know is, what are the right steels for your new and unfamiliar requirements—and how they can be put through your manufacturing processes with the least waste, trouble and delay.

Fortunately, we are in a position to supply this information. Here at Carnegie-Illinois we have developed a corps of industrial "trouble-shooters"—engineers and metallurgists whose special job is not to sell steel but to help industry use it more *efficiently*. Their intimate knowledge of the constantly changing steel picture will safely guide you through the complex problem of proper steel selection. Their practical experience with the most advanced shop methods in using the many new and special steels now available will help you avoid time-wasting errors.

In working on your problems, these men can call upon the facilities of the most completely equipped research laboratories and the finest steel-making plants in America. Their advice can be entirely unbiased because they have the most comprehensive range of metallurgy's finest steels from which to choose.

This service is not new. It was initiated long before the present emergency. It is seasoned, tried and widely experienced. We offer it freely to any manufacturer who is anxiously studying unfamiliar blue prints and is seeking a practical way out from a situation that bristles with new problems. We believe we can help you. We welcome the opportunity.

CARNEGIE-ILLINOIS STEEL CORPORATION

Pittsburgh and Chicago

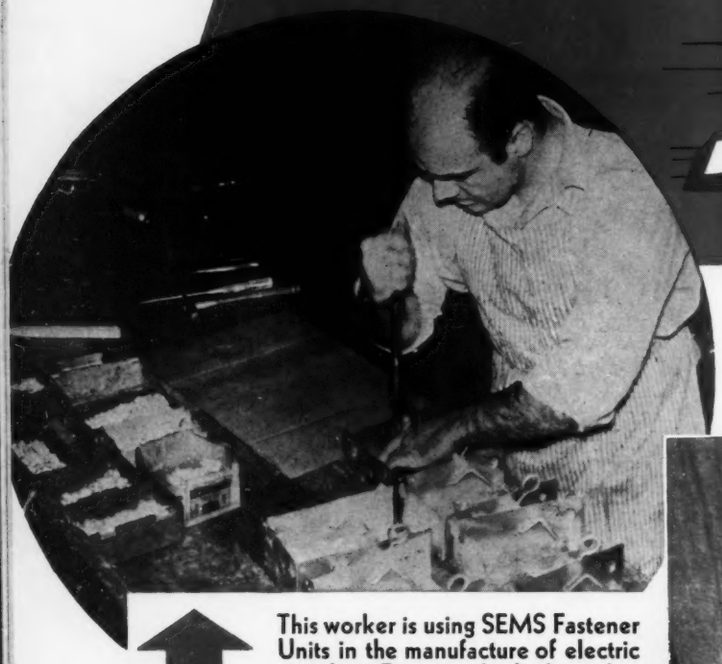
Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York

USS

UNITED STATES STEEL

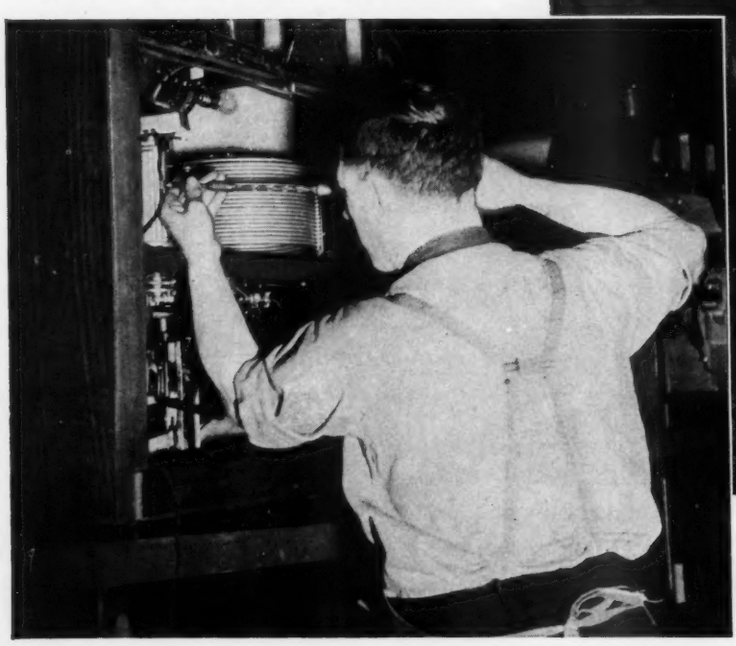
See what you

SEMS*



This worker is using SEMS Fastener Units in the manufacture of electric switches. Because the lock washer can't drop off they handle easier and faster . . . and no screw can be driven without a lock washer to keep it tight!

In the automotive industry, where they are used by the millions, SEMS Fastener Units definitely reduce assembly costs and assure tighter, stronger fastenings!



By eliminating time formerly wasted in placing lock washer on screw, SEMS Fastener Units speed up production of automatic record-changing phonographs!

"Fastening Headquarters"

SHAKEPROOF

SEMS Fastener Units . . . Lock Washers . . . Locking and Plain Terminals

Thread-Cutting Screws . . . Locking Screws . . . Spring Washers . . . Special Stampings

can save with *Fastener Units!*

NEW COST ANALYSIS CHART ...reveals actual dollars and cents savings over unassembled lock washers and screws!

Here's your opportunity to determine accurately what SEMS Units can save in your assembly work. The new Cost Analysis Chart proves conclusively that this preassembled Shakeproof Lock Washer and Screw unit will reduce your costs and, also, give better fastenings. Every metal product manufacturer should follow its simple formula to figure what his savings will be with SEMS Fastener Units.

WRITE FOR YOUR CHART!

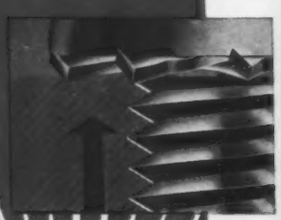
The coupon below will bring you a free copy of this new Cost Analysis Chart. It also illustrates many other advantages of this unit which help speed up production and improve product quality. Clip the coupon now!

SHAKEPROOF LOCK WASHER CO.
Distributor of Shakeproof Products Manufactured by ILLINOIS TOOL WORKS
2523 North Keeler Avenue, Chicago, Illinois
Plants at Chicago and Elgin, Illinois
In Canada: Canada Illinois Tools, Ltd., Toronto, Ontario
Copyright 1940 Illinois Tool Works

No time wasted putting lock washers on screws!

No "bottle-necks"—faster assembly assured!

No lost lock washers—an important saving!



Greater driving power—reduced cam-out tooth contact area head!

Lock Washer can't come off ... but is free to rotate!

* SEMS is the registered trademark of the Illinois Tool Works, manufacturers of Shakeproof Lock Washers. Only Shakeproof Lock Washers are used in the manufacture of SEMS Fastener Units.

MAIL COUPON TODAY!

SHAKEPROOF LOCK WASHER CO.
2523 No. Keeler Ave., Chicago, Ill.

Send us your new Cost Analysis Chart. We want to see how much we can save by adopting SEMS Fastener Units!

Firm Name _____

Address _____

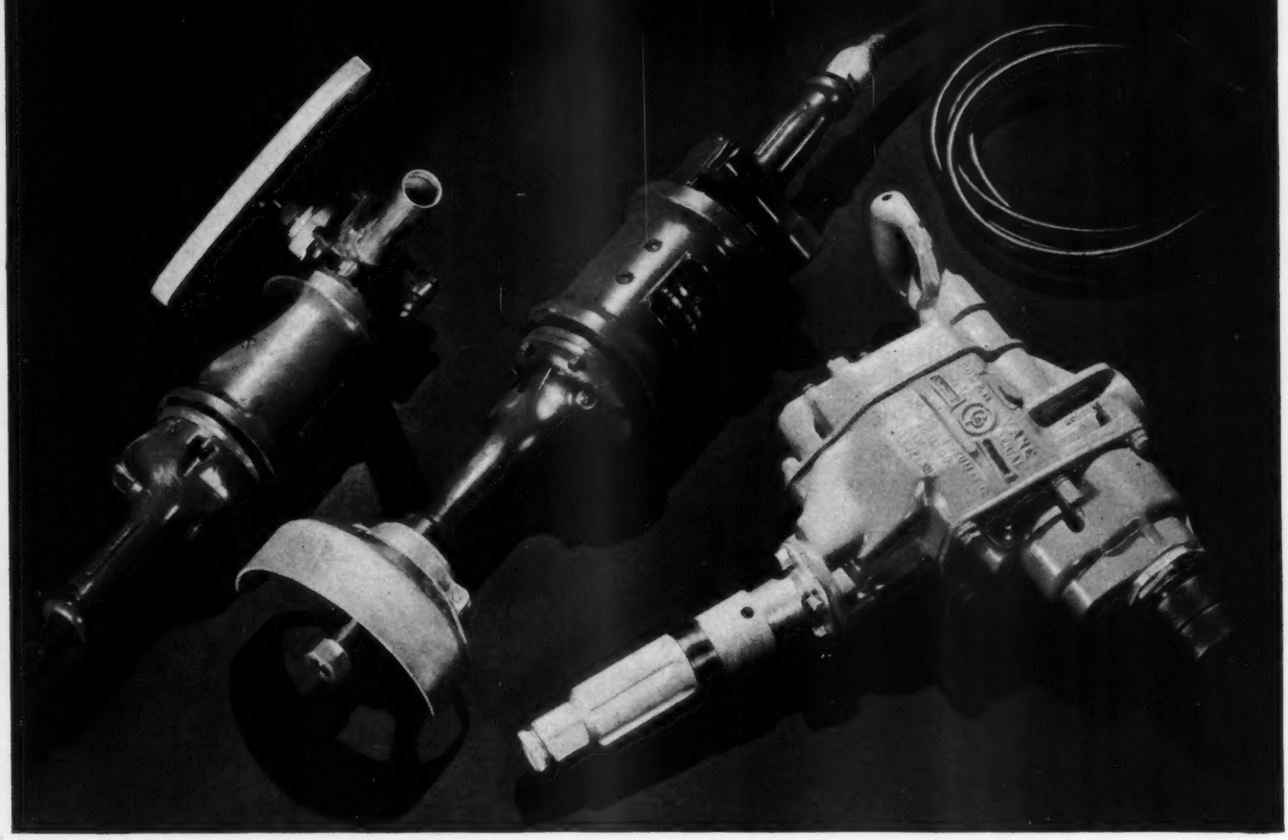
City _____ *State* _____

Signed by _____ *Title* _____

MAZLO
Reg.U.S.Pat.Off.

MAGNESIUM ALLOYS

THE LAST WORD IN LIGHTNESS



Built for Man-Handling

MAZLO Magnesium parts make these CP electric and pneumatic portable tools much lighter in weight. Workers using them save considerable effort, ordinarily wasted. Jobs go faster, with less fatigue.

Strong MAZLO Magnesium Alloys are used by Chicago Pneumatic Tool Company in building these tools. They have the toughness and stamina demanded by the grinding, sanding, drilling and nut-running jobs they're set to do.

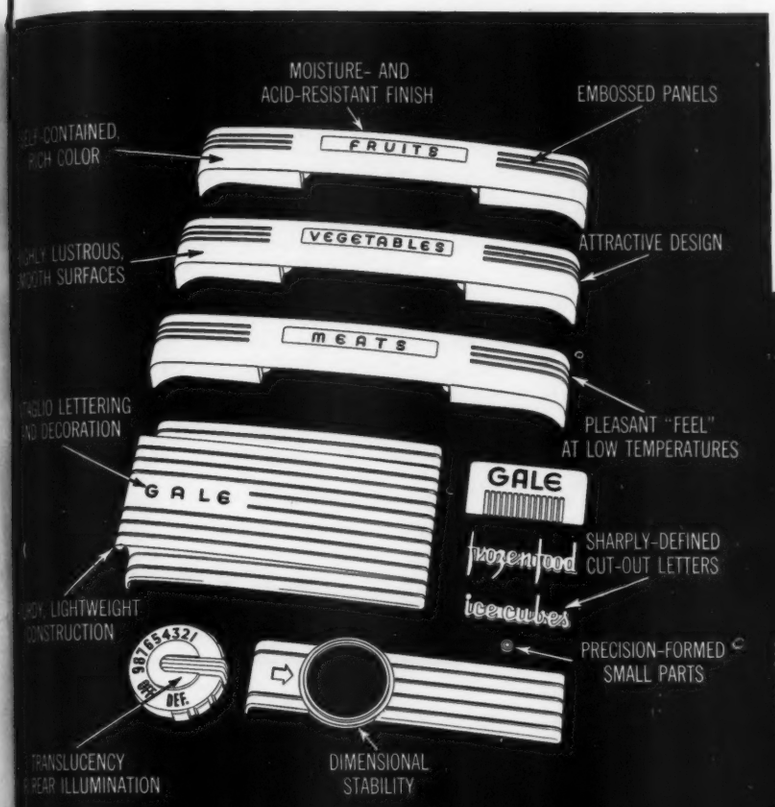
Reducing weight that has to be moved, by man or machine, allows that action to be speeded up. It cuts wear and tear on the mover. That is why both men and machines like the lighter weight of MAZLO Magnesium Alloys. Sales Agent: Aluminum Company of America, 1702 Gulf Building, Pittsburgh, Pennsylvania.

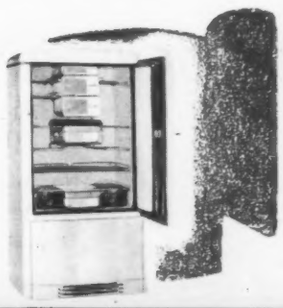
MAZLO

AMERICAN MAGNESIUM CORPORATION

BY RE-DESIGNING WITH BAKELITE POLYSTYRENE—

Interior Parts of Gale Refrigerator Gain Improved Appearance at Low Cost





BY ECONOMICALLY re-styling interior parts with Bakelite Polystyrene, the manufacturers of Gale refrigerators "obtained designs not possible with other materials without prohibitive costs." Possessing self-contained color and highly lustrous surfaces, these parts withstand constant handling, moisture, food-acids and low temperatures. With every constructional detail formed completely in the molding process, they require neither machining nor finishing.

Learn more about the styling opportunities and fabricating economies obtainable with colorful Bakelite Plastics by writing for illustrated booklet 33P, "New Paths to Profits."

BAKELITE CORPORATION
Unit of Union Carbide and Carbon Corporation
UCC
30 EAST 42ND STREET, NEW YORK

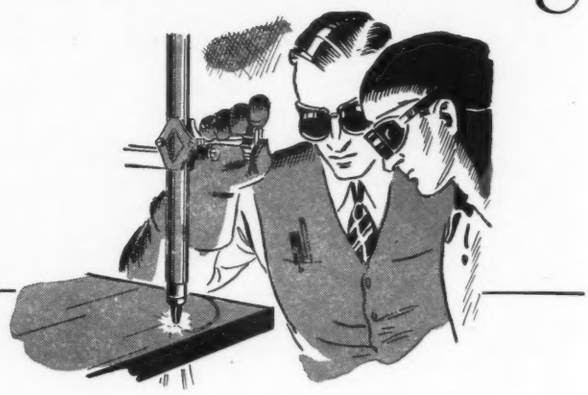
BAKELITE
TRADE MARK

The word "Bakelite" and the identifying products Symbol are registered trade-marks of Bakelite Corporation

PLASTICS HEADQUARTERS

How Oxy-Acetylene Flame-Cutting

can ease the burden on your Machine Tools



OXY-ACETYLENE machine flame-cutting is a means of shaping steel to relatively close tolerances — rapidly and economically.

Steel of practically any commercially used size or thickness can be cut in straight lines, circles, or intricate shapes, with cut edges so clean and accurate that a minimum of machining is required. In many cases, no machining is needed at all. This leaves your machine tools and machinists available for other needed work.

Some of the other advantages of flame-cutting are:

Operators of flame-cutting machines can be trained to do good work in a short time. The investment for equipment is moderate.

Less Dependence on outside sources of supply for fabricated parts is made possible by ability to make what you need as you need it.

One-of-a-Kind production for replacement or new-model development work is economically practical with flame-cutting, and is usually much faster than by other methods.

Parts Inventories can be held down, because almost any parts can be produced immediately as needed from stock steel.

Savings in Weight and bulk, and in most cases, increase in strength over parts fabricated by older methods are made possible by the use of flame-cut and welded parts.

Design Changes can be made quickly, without loss of time or money for new dies, molds, or patterns. Change-overs on flame-cut parts are only a matter of minutes.

Semi-Automatic cutting can be done by using easily fabricated templets which guide the blowpipe. The operator can also "hand trace" direct from a drawing.

Quantity Production can be facilitated by cutting numerous parts simultaneously — either by "stack-cutting" or by multiple blowpipe operation.

and how Linde can help you use it!

The Linde organization can supply you with small portable or large stationary flame-cutting machines. You can also obtain from Linde—oxygen, acetylene, carbide, and other essential materials for using flame-cutting, with the assurance of dependable, uninterrupted deliveries.

Even more important, Linde has the process ability and the organization to supply on-the-job assistance which will contribute to the technical skill and training of your operators.

If you want to know more about how Linde can help you use flame-cutting or other oxy-acetylene processes, ask Linde.

THE LINDE AIR PRODUCTS COMPANY

Unit of Union Carbide and Carbon Corporation

UCC

New York, N. Y., and Principal Cities

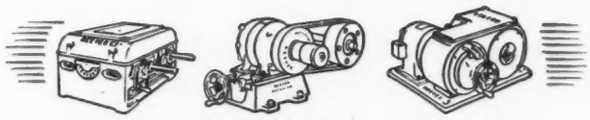
In Canada: Dominion Oxygen Company, Limited, Toronto

Linde can also help you make effective use of oxy-acetylene welding . . . hard-facing . . . flame-cleaning . . . flame-hardening . . . gouging . . . descaling . . . pipe-welding . . . Unionmelt welding . . . and other useful processes.

LINDE OXYGEN . . . PREST-O-LITE ACETYLENE . . . UNION CARBIDE
OXWELD, PUROX, PREST-O-WELD APPARATUS . . . OXWELD SUPPLIES

The words "Linde," "Prest-O-Lite," "Union," "Oxweld," "Purox," "Prest-O-Weld," and "Unionmelt" are trademarks of Units of Union Carbide and Carbon Corporation.

How Reeves Makes It EASY *to Incorporate Speed Control* CORRECTLY



Transmission Motor Pulley Motodrive

1 COMPLETE LINE OF ADAPTABLE UNITS

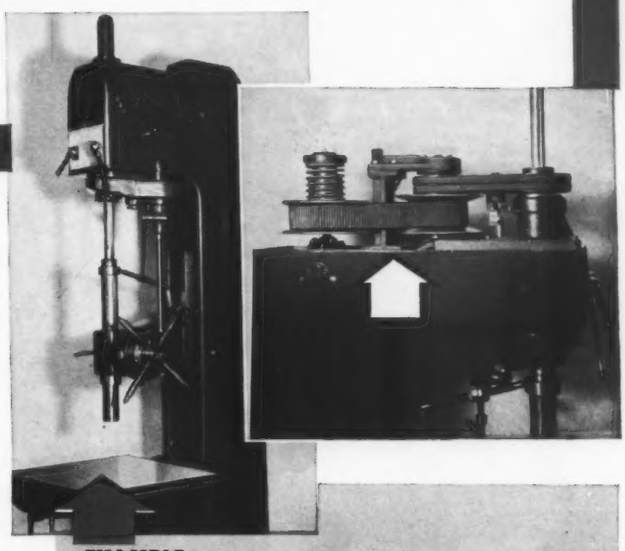
These are the three basic units around which REEVES builds a complete line of modern, compact variable speed control equipment—a wide range of designs, controls, sizes to 78 h.p. and speed ratios 2:1 through 16:1. Machine builders who adopt REEVES Speed Control are free from the limitations imposed by one standard design. You can plan your application from the most practical and economical standpoints, to meet your needs exactly.

2 NATION-WIDE ENGINEERING STAFF

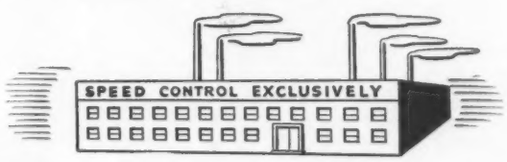
Located in 35 industrial centers are factory-trained, seasoned REEVES engineers prepared to counsel with you on factors calling for thorough and careful judgment—speed variations, horsepower requirements, available space, driving connections, methods of control.

3 BROADEST EXPERIENCE IN THE FIELD

You benefit by REEVES unequalled experience in providing speed control as standard equipment on 1,376 different makes of machines. More than 140,000 REEVES units are now in service in over 18,000 plants. From no other source can you obtain so much practical experience.



EXAMPLE: To provide this modern drill press with complete speed flexibility, the manufacturer uses the REEVES Motodrive internal operating parts (without case) installed within the head of the press. *Above, right:* head removed to show installation of this space-saving REEVES unit which combines motor, speed varying mechanism and (if required) reduction gears. REEVES also offers Transmission operating parts only (without frame) for incorporating in design of a machine.



4 REEVES SPECIALIZES IN SPEED CONTROL

Variable Speed Control is a specialty with REEVES—not a side-line. REEVES "lives" speed control. That's why we can offer a complete line of units instead of only a few standard models. That's why you get prompt action on your requirements.

★ ★ ★

Send today for copy of 124-page Speed Control Manual and Catalog G-397, which describes REEVES *units and shows how machine builders are incorporating them as standard equipment to release the full capacities of their machines.*

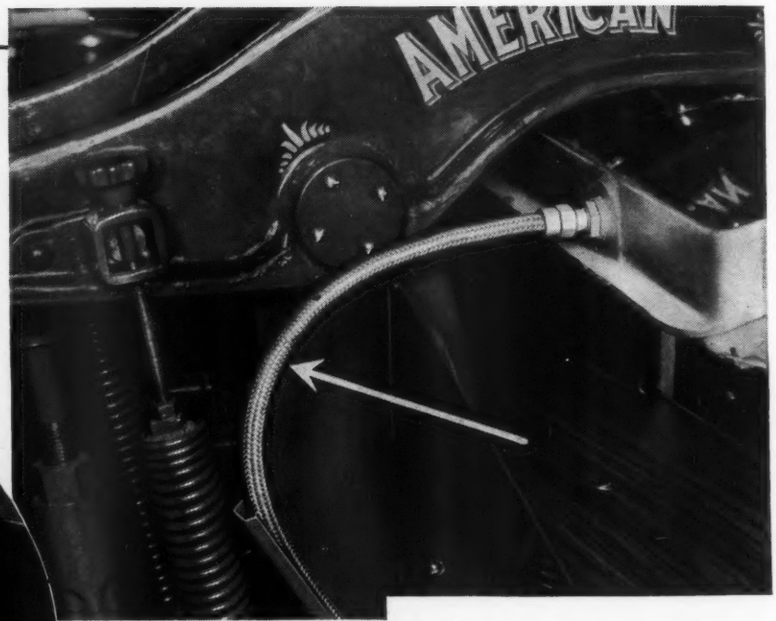
REEVES PULLEY COMPANY, *Dept. K,* COLUMBUS, INDIANA

REEVES ACCURATE POSITIVE SPEED CONTROL

The "MISSING LINK" designers have been looking for...

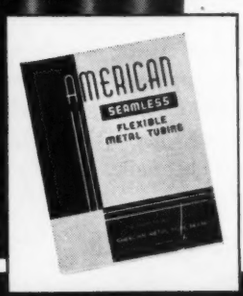
CONNECTORS OF FLEXIBLE METAL HOSE

Binding, leaky swing joints that cause steam losses and downtime losses for repacking have been replaced by American Seamless Flexible Metal Tubing on leading makes of laundry and dry cleaning presses. The reason is simple. American Seamless is tight under pressure, neat in appearance and easy to install... yet it's as flexible as garden hose and amazingly resistant to fatigue. It never requires packing.



Here American Metal Hose performs a simple task at a cost consistent with this use. Not so simple are thousands of other uses of flexible metal hose such as in hydraulic jack lines where pressures run up to 3,000 lbs. per sq. in. or in oil transfer lines where abuse, constant flexing or chemical action takes toll of inferior constructions.

←The C-O-Two Fire Equipment Company uses flexible metal tubing to increase the speed on the tank filling line. Flexible connections make connecting and disconnecting a matter of seconds. Being metal and seamless, the connections insure the utmost safety in the handling of the gas. This company, like hundreds of others, has found that American Seamless is best for the conveyance of gases and liquids under pressure.



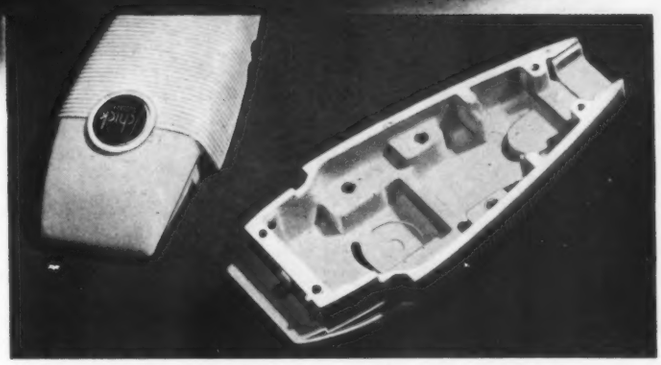
SS-25 is the number of our American Seamless Catalog. The book contains more than 70 pictures illustrating the numerous uses of this super-tubing. Construction details, application information and important engineering material will be found in its 24 pages. Be sure to ask for a copy. A note will bring you one by return mail. 40247

American Metal Hose

ANACONDA
from mine to consumer

AMERICAN METAL HOSE BRANCH of THE AMERICAN BRASS COMPANY
General Offices: Waterbury, Conn. • Subsidiary of Anaconda Copper Mining Company
In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

new BEAUTY *and* EFFICIENCY



Mr. Loewy's design for the Schick Shaver housing of BEETLE is an excellent example of good technique in combining beauty and functional efficiency.

SCHICK SHAVER DEMONSTRATES HOW BEETLE MEETS ALL BASIC REQUIREMENTS OF A SALES WINNING DESIGN

Designed by Raymond Loewy and molded of BEETLE* in cream and maroon colors, this new 1941 Schick Shaver won top award in the Annual Modern Plastics Competition. It has a simple but powerful appeal and is eminently practical—strong, compact, sanitary, economical to produce. The fluted surface, part of the functional design, is obtained in Beetle in the single molding operation—no extra production steps are required. Beetle's insulating value for both electricity and temperature also contribute to making it the ideal material for this type of product. Add to these advantages the brilliant, permanent color that is a part of the material itself and you will immediately see why Beetle is reducing the costs *and* increasing the sales of many products.

For housings of many products Beetle offers unmatched advantages. It is all color—and available in all colors. Perhaps you have a housing or product design problem that Beetle can solve in short order with quick economy. Call on our staff—a member will be glad to give you the benefit of his special knowledge of molding and materials.

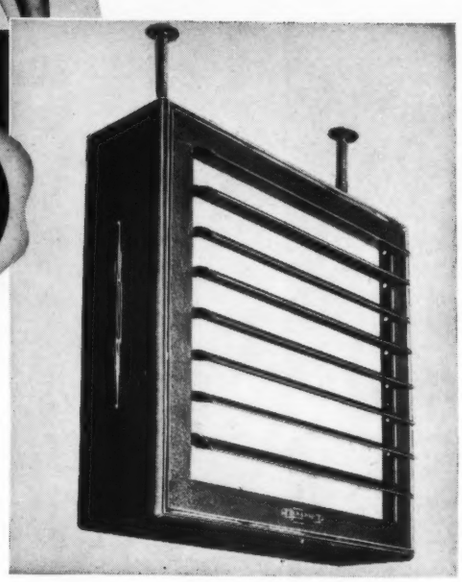
This New Technical Booklet contains practical information on the properties and applications of BEETLE and new facts pertinent to modern molding methods. You will find it profitable as a reference guide in your selection of plastic parts—a copy is yours for the asking.

AMERICAN CYANAMID COMPANY
Beetle Products Division
32 ROCKEFELLER PLAZA, NEW YORK, N. Y.

*Trademark of American Cyanamid Company applied to urea products manufactured by it.

Beetle THE PLASTIC THAT'S ALL COLOR—IN ALL COLORS

Added to KRAMER TRENTON EFFICIENCY IS FINISH PROTECTION *By Bonderizing*



Based on a quarter of a century of accumulated experience in design and construction, the Kramer Trenton Company is contributing advanced ideas in heating and air conditioning for the home, office and factory.

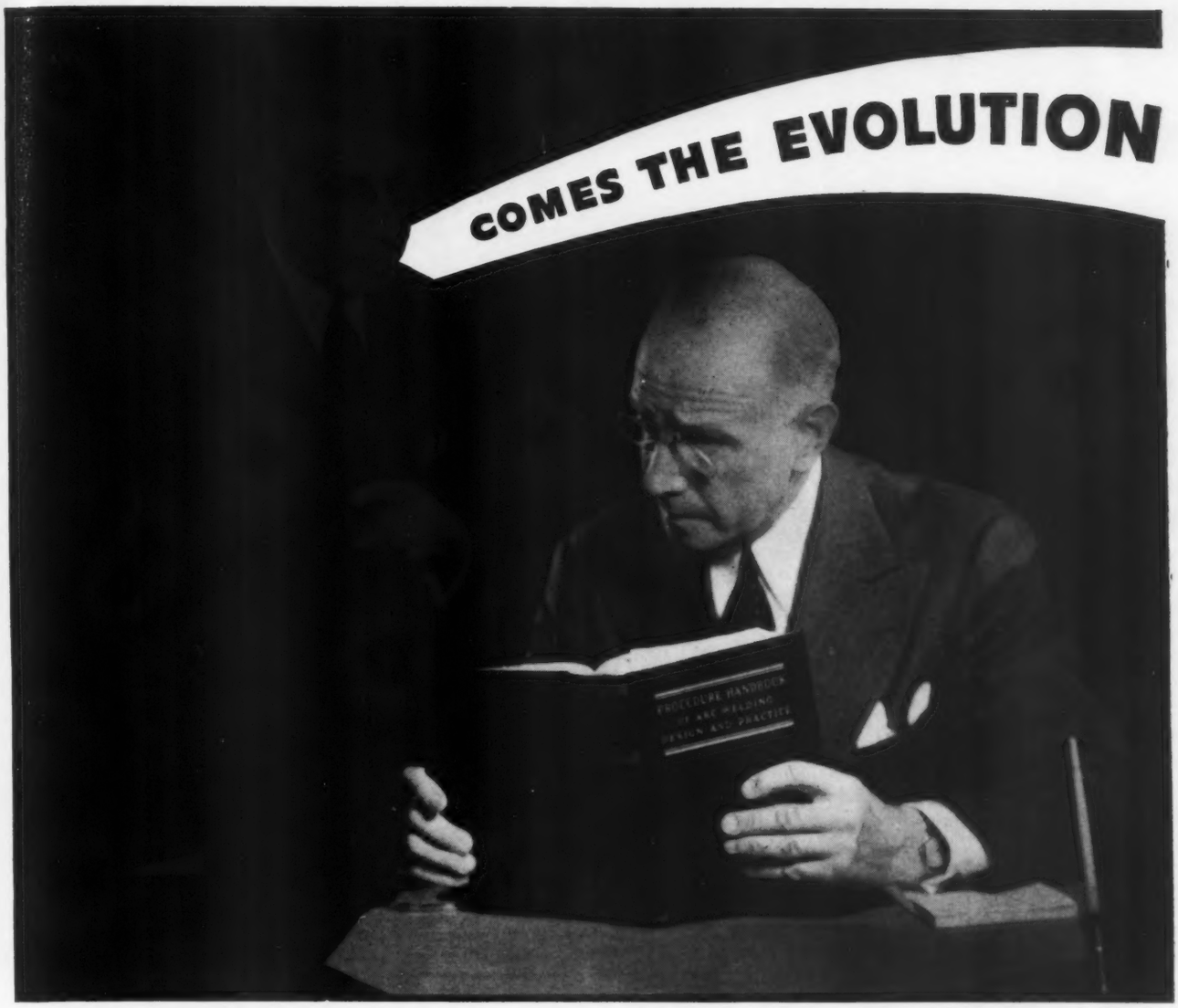
Scientifically designed for top efficiency, the mechanical assemblies are housed in beautifully finished cabinets, that are Bonderized for a long, rust-free life.

Bonderizing supplies an extra quality. Applied under the enamel it provides an absorbent foundation to which the finish will cling. It neutralizes the effects of humidity and protects against rust. Its effectiveness on this type of equipment proves its value on any product where corrosion is a problem.

PARKER RUST PROOF COMPANY
2179 E. Milwaukee Ave. • Detroit, Michigan

Send for the latest book on Bonderizing. It describes what it is—what it does—how it is applied and lists some of the hundreds of manufacturers who use it. In this list you will find some of the greatest names in American industry.

PARKER
Processes **CONQUER RUST**
BONDERIZING • PARKERIZING



ALTER EGO: Literally "one's other self"—the still, small voice that questions, inspires and corrects our conscious action.

ALTER EGO: "Now pity a sorrier fate if you can: A vagabond soul in a stay-at-home man." Remember that poem?

Meaning what?

ALTER EGO: Meaning you're that way about arc welding. You'd like to improve your product and enjoy the saving in cost—BUT you'd rather sit comfy with the old familiar production process.

But we haven't the time *these days to change barrels while going over Niagara Falls.*

ALTER EGO: Then don't change barrels. The most rabid redesign enthusiast will tell you that redesign for arc welding is a matter of evolution, not revolution.

You mean we should do it one step at a time—like learning to walk?

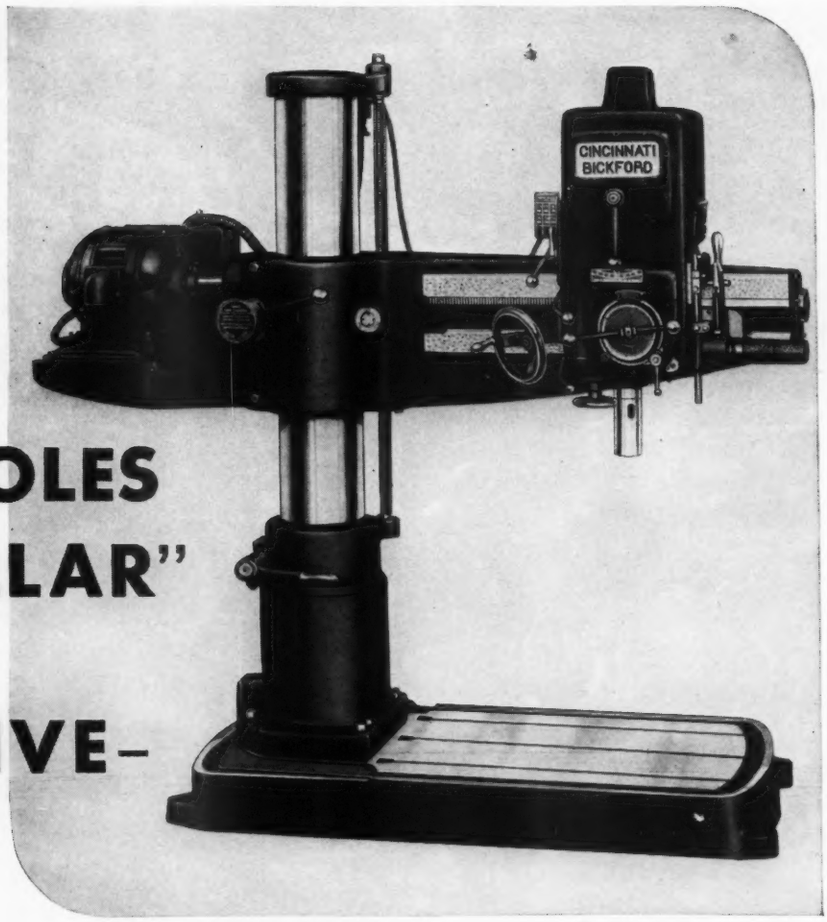
ALTER EGO: Exactly, then when you've perfected the production of one part, take the second step —redesign the next part; and before you know it, you and the product are on the way to town.

• •

LINCOLN SUGGESTS: To the man who thinks he hasn't time or who doesn't know how to change over to welding, we offer this suggestion: See how others, with problems like your own, have started out with welded design. The booklet, "How to Changeover to Welded Design for Profits" (gratis) gives the evidence and a start.

LINCOLN "SHIELD-ARC" WELDING THE LINCOLN ELECTRIC COMPANY Cleveland, Ohio

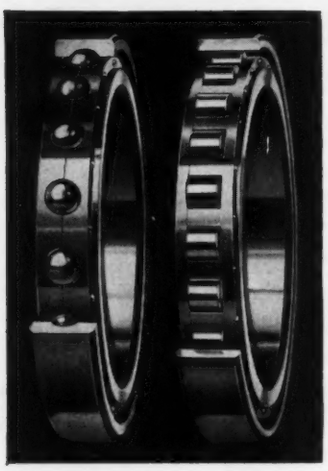
Authoritative Information on Design • Production • Welding Equipment



"MORE HOLES PER DOLLAR" *is the* OBJECTIVE– *So*

CINCINNATI BICKFORD *Chooses* "NORMA-HOFFMANN"

PRECISION BEARINGS



Where you are cramped for space, yet seek the utmost in accuracy, rigidity, load capacity and friction-free operation, use NORMA-HOFFMANN EXTRA LIGHT "XLS" BALL BEARINGS or EXTRA LIGHT "RXLS" ROLLER BEARINGS — available in a size range from 1⅜" to 22½" in bore.

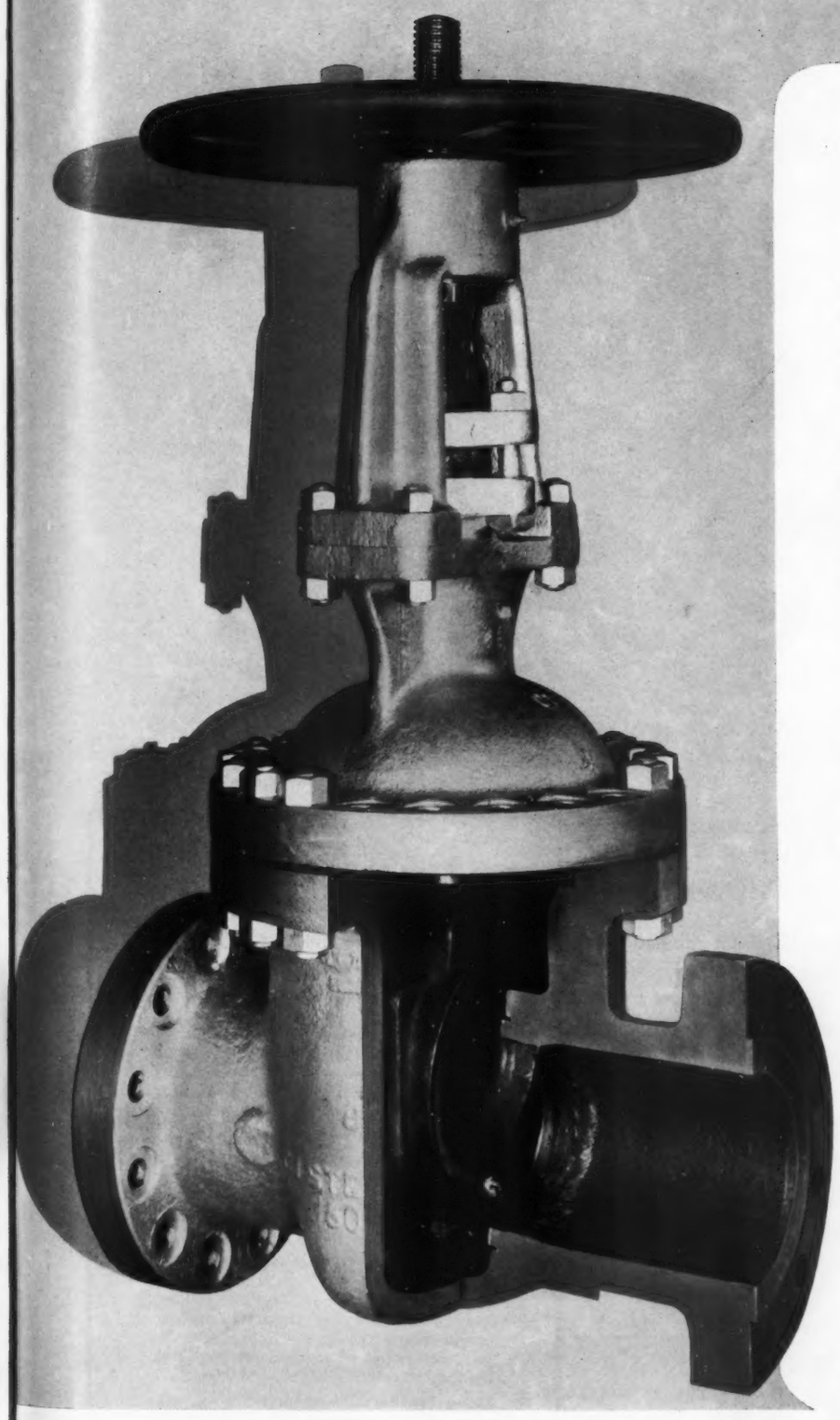
In its latest High-Speed All-Geared "SUPER-SERVICE" Radials—as in its earlier models—Cincinnati Bickford Tool Company (Cincinnati, Ohio) employs NORMA-HOFFMANN BEARINGS at those vital points where their PRECISION and friction-free characteristics contribute to the speed, maneuverability, compactness, rigidity and accuracy of the drills themselves.

In the motor reduction gear are four NORMA-HOFFMANN "XLS" Extra Light Ball Bearings; three more of the same type are in the arm elevating mechanism, another in the column sleeve support. These bearings afford extreme compactness, with the desired load capacity, at the same time meeting other design requirements in the minimum of space. Another NORMA-HOFFMANN Ball Bearing is in the speed change gear.

What is YOUR bearing problem? Let our engineers work with you. Write for the Catalog.

NORMA-HOFFMANN BEARINGS CORP'N., STAMFORD, CONN., U.S.A.

VALVES ARE BETTER



...when made of Steel Castings

Whatever you make, you can safely follow the example of leading valve manufacturers if you want to improve your product and cut costs.

More and more valves are now being made of steel castings, and they are stronger, more rigid, longer-wearing valves —able to resist high temperatures and pressures. Cast steel contributes these desirable qualities, plus lower cost, less machining to do, and a wide choice of mechanical properties.

Your own foundryman will gladly show you how your products may be similarly improved by a wider use of steel castings. Or you may consult, without obligation, Steel Founders' Society, 920 Midland Building, Cleveland, Ohio.

Steel Castings bring you these advantages

1. Uniform structure, for greater strength, shock and stress resistance.
2. Metal distributed where it will do the most good; maximum strength with minimum weight.
3. Widest range of mechanical properties.
4. Good machining qualities, low finishing costs, better streamlined appearance.
5. High rigidity, minimum deflection, accurate alignment, close tolerances and better fit.
6. Readily weldable in composite structures.
7. High fatigue resistance, maximum endurance and longer life—ideal for critically stressed parts.

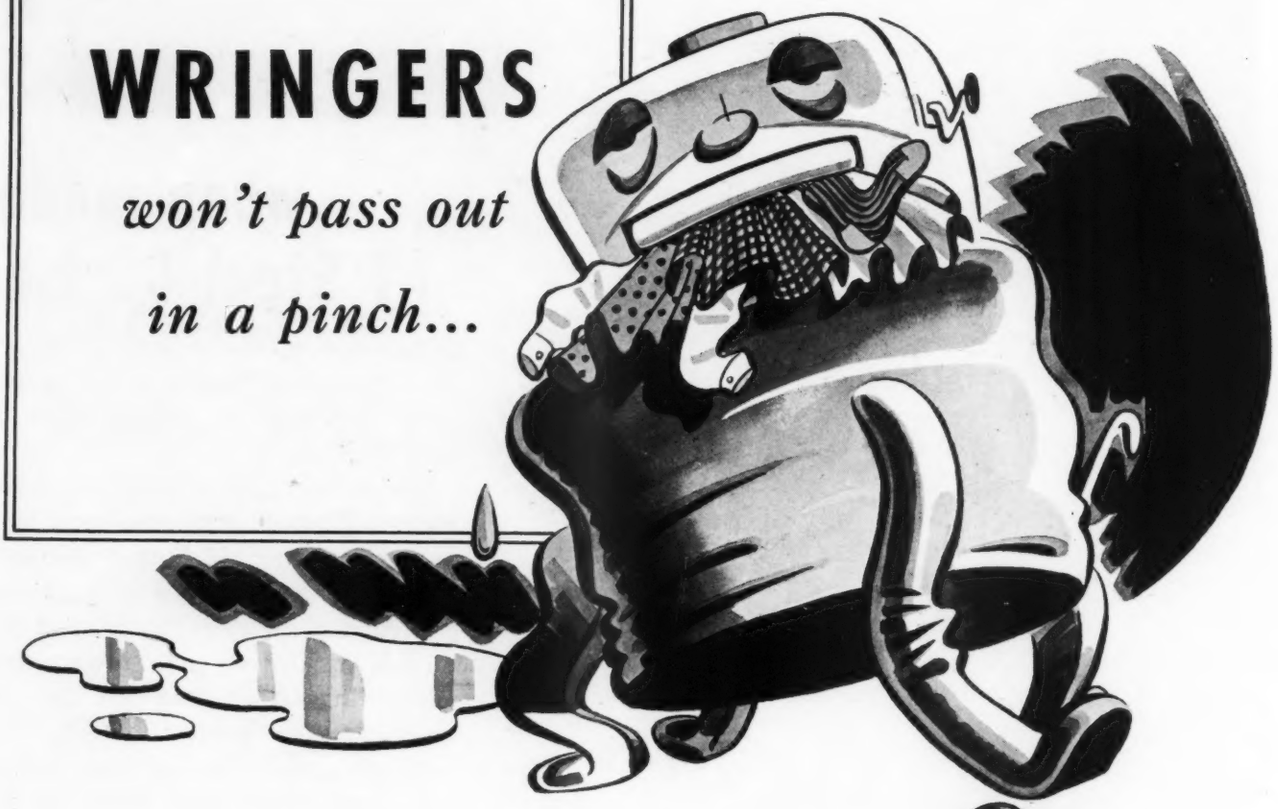
MODERNIZE YOUR PRODUCT WITH

STEEL CASTINGS

WRINGERS

won't pass out

in a pinch...



when given Klixon Motor Protection

Put a Klixon Protector in a washing machine's motor, and you make the motor positively safe against overheating and burnouts. Even jamming the wringer can't hurt the motor. Damage, service calls and fires are eliminated.

For if the wringer jams with clothes, a washing machine motor with a built-in Klixon Manual Reset Protector automatically shuts itself off the instant it starts to overheat. *And it can't start again* until safely cooled and *released by its manually-operated push button.* In this way, fingers trying to release clothes cannot be drawn into the bite of a live wringer.

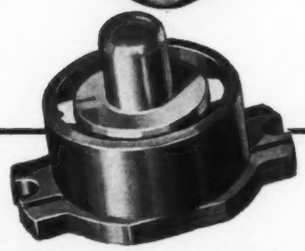
Millions of unattended motors are now operating with built-in Klixon Protectors—not only because of the personal safety feature—but because these protectors prevent motor burnouts, insure safe peak output and increase the motor's life.

Ask any motor manufacturer for motors with inherent Klixon Protectors. Both automatic and manual reset types available.

KLIXON

TRADE MARK REG U S PAT. OFF.

SPENCER THERMOSTAT COMPANY
912 FOREST STREET, ATTLEBORO, MASSACHUSETTS



Klixon gives you the most extensive line of motor protection available

Below are the sizes and application ranges

Klixon ½" Protector—Provides inherent overload and overheat protection for fractional horsepower, single-phase motors up to ¼ H. P. Also used as an inherent temperature control unit on large integral horsepower, poly-phase motors.

Klixon 1" Protector—Provides built-in overload and overheat protection for fractional horsepower, single-phase motors through 1½ H. P. Breaks the load directly.

Klixon 1½" Protector—Provides inherent overheat and overload protection for single- and poly-phase motors above 3 H.P.—available for inherent protection against overheating and excessive current (breaking pilot circuit of motor contactor, not the load directly).

Klixon Two-Pole Protector—For certain types of fractional H. P. repulsion-start induction and capacitor motors. Simplified protection on 3-phase motors up through 3 H. P. breaking the line directly.

NEVER MORE THAN A FEW HOURS FROM AUTHORIZED FACTORY MOTOR SERVICE

Another Reason WHY BRIGGS & STRATTON IS PREFERRED POWER!

Preferred Power for Hundreds of Different Types of Machines, Tools, Appliances — For Home, Farms and Industrial Use.

East — west — north — and south — you will find authorized Service Stations, manned by factory trained men equipped with special factory tools, ready to take care of any emergency — to adjust, repair, or rebuild any model of Briggs & Stratton motor, even though it's a veteran of 10 or 20 years of service. This nation-wide authorized factory service is maintained to protect your investment in Briggs & Stratton gasoline motors — an important added advantage recognized by manufacturers, dealers and users.

BRIGGS & STRATTON CORP.
MILWAUKEE, WISCONSIN, U. S. A.

IT'S POWERED RIGHT WHEN IT'S POWERED BY BRIGGS & STRATTON

KNURLED

Unique "UNBRAKO" refinements that help you to do a better job

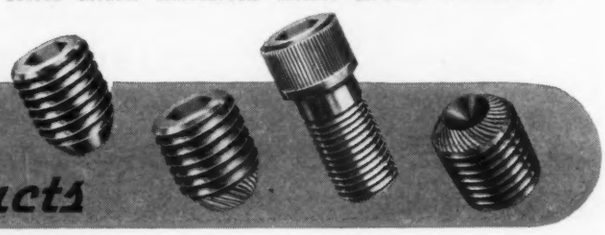
. . . *A BETTER JOB* with "Unbrako" Cap Screws because the cold-forged knurled heads gear right to the fingers and prevent annoying finger slip. They turn faster and farther before applying wrench or pliers, hence speed up assembly. Finished appearance is neater on any product.

. . . *A BETTER JOB* with "Unbrako" Self-Locking Hollow Set Screws because their knurled points insure a vibration-defying grip. Set them up with no more than average pressure and they *hold tight!* Save maintenance costs . . . prevent costly trouble. Yet "Unbrako" Self-Lockers are easily applied or removed and can be used over and over again.

Get complete information now. Ask your distributor, or write—

STANDARD PRESSED STEEL CO.
JENKINTOWN, PENNA. BOX 545
BRANCHES
BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO

Reg. U. S. Pat. Office
UNBRAKO *Screw Products*



Gift to Industry
BOWER
ROLLER BEARING CO.
Detroit, Michigan

OUT OF THIS *"Bag of Tricks"*

HERE IS ONE of the most interesting collections you have ever seen. Everything from windshield wiper blades to flexible tubing . . . decorative trim to fish lures . . . nails to vacuum cleaner parts. 51 products, all in current production, all made of U·S·S Stainless Steel. Ask your U·S·S Steel representative to have one of our Stainless Specialists show it to you.

YOU will enjoy looking over the 51 items contained in this kit. Each one represents a product in which U·S·S Stainless Steel has come to the aid of a product engineer. Each is a better product, more useful, longer lasting, cheaper, or faster selling, because U·S·S Stainless Steel has been judiciously used in its manufacture.

These products illustrate how U·S·S Stainless Steel can be pressed, punched, drawn, formed, or welded by standard shop methods into whatever shape your assembly requires. Truly a goldmine of ideas for any engineer or designer.

U·S·S Stainless Steel is used in these and countless other products—because it is permanently bright, resistant to corrosion and abrasion, and easily formed and fabricated. Its extremely high tensile strength permits use of lighter sections, saving weight and often reducing costs below those of plated or combination parts. Ask today to have one of our Stainless Specialists show you this sample kit.

USS

STAINLESS STEEL

AMERICAN STEEL & WIRE COMPANY, *Cleveland, Chicago and New York*
CARNEGIE-ILLINOIS STEEL CORPORATION, *Pittsburgh and Chicago*
NATIONAL TUBE COMPANY, *Pittsburgh*

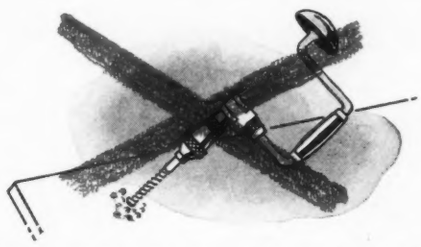
Columbia Steel Company, San Francisco, *Pacific Coast Distributors*
United States Steel Export Company, New York · Scully Steel Products Company, Chicago, *Warehouse Distributors*

UNITED STATES STEEL

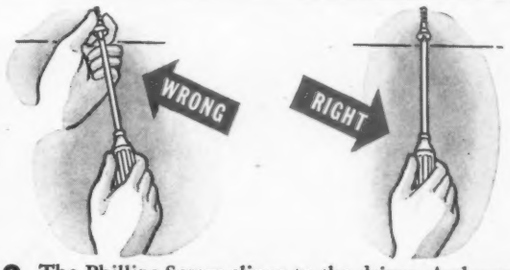
Get rid of Slow-Poke Fastening

PHILLIPS SCREWS CUT ASSEMBLY TIME IN HALF — SPEEDING UP DELIVERY OF YOUR PRODUCT...

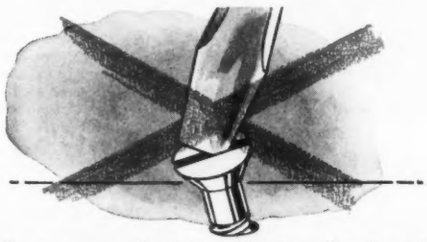
As far as assembly work is concerned, you can *halve* the time to delivery dates by changing over to the *fast* fastening method — with Phillips Recessed Head Screws . . .



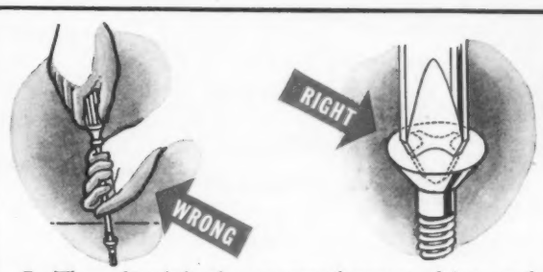
1. Pilot holes eliminated. Start right out driving. You can use one hand to steady the work because . . .



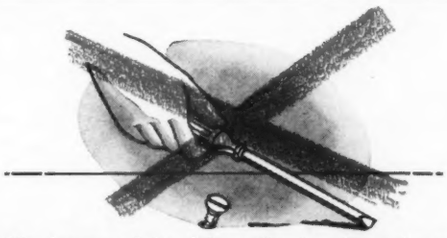
2. The Phillips Screw clings to the driver. Awkward places easily reached—without danger of fumbling.



3. No more crooked screwdriving, for the Phillips Screw drives straight automatically. Driving is easier because . . .



4. There is triple the contact between driver and recess. Power drivers are used more often because there is . . .



5. No danger of the driver slipping from the recess and gouging the finished surface. Phillips Screws set up tight . . .

6. Without burrs or split heads. Today, increased production requirements almost *demand* Phillips Screws. More firms standardize on Phillips every day. Get in touch with one of the firms below.

PHILLIPS RECESSED HEAD SCREWS

WOOD SCREWS · MACHINE SCREWS · SHEET METAL SCREWS · STOVE BOLTS
SPECIAL THREAD-CUTTING SCREWS · SCREWS WITH LOCK WASHERS

SPEED PRODUCT DELIVERIES BY CUTTING ASSEMBLY TIME

U. S. Patents on Product and Methods Nos. 2,046,343; 2,046,837; 2,046,839; 2,046,840; 2,082,085; 2,084,078; 2,084,079; 2,090,338. Other Domestic and Foreign Patents Allowed and Pending.

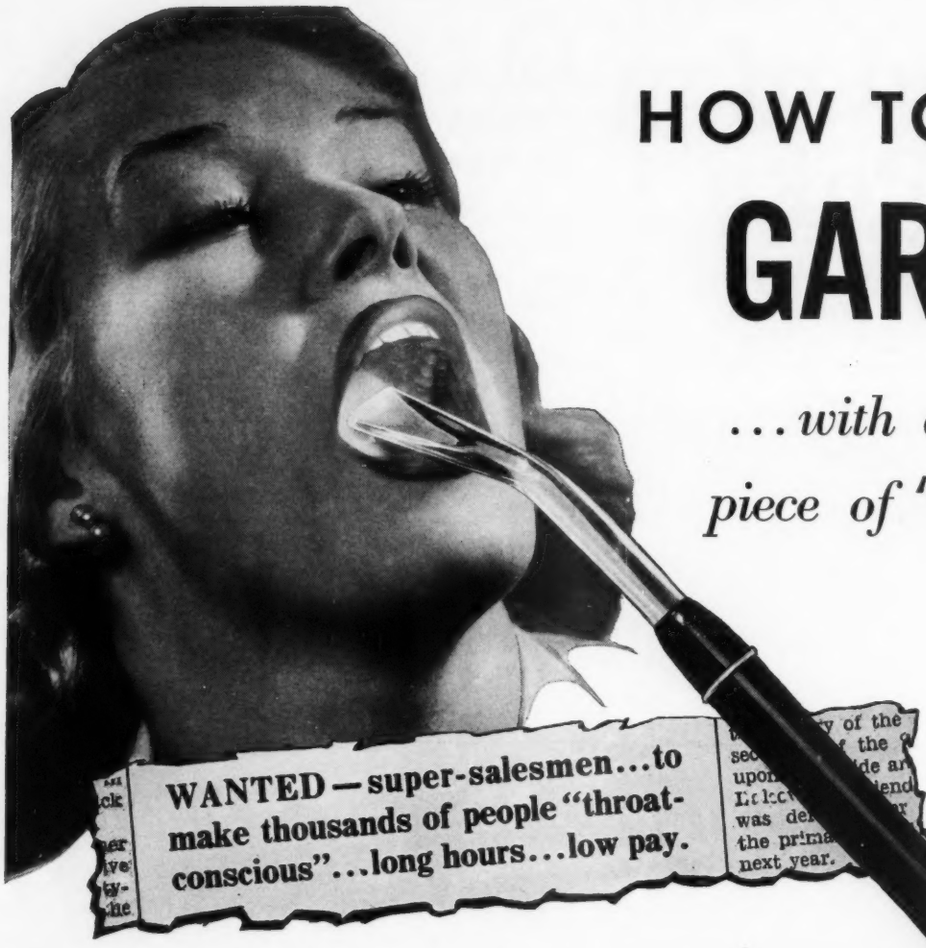
American Screw Co., Licensee, Providence, R.I.
Continental Screw Co., New Bedford, Mass.
Corbin Screw Corporation, New Britain, Conn.

The Lamson & Sessions Co., Cleveland, Ohio
National Screw & Mfg. Co., Cleveland, Ohio
Parker-Kalon Corporation, New York, N.Y.
Pheoll Manufacturing Company, Chicago, Illinois

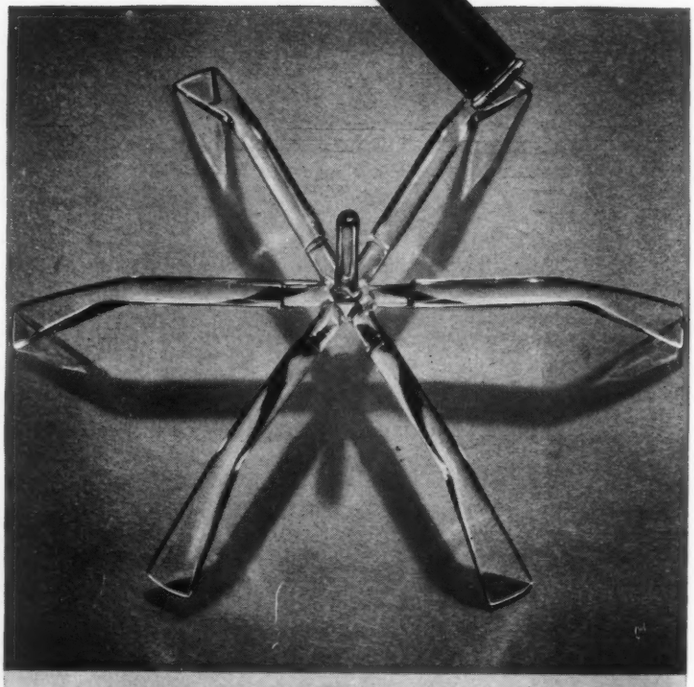
Russell, Burdsall & Ward Bolt & Nut Co., Port Chester, N.Y.
Scovill Manufacturing Co., Waterbury, Conn.
Shakeproof Lock Washer Co., Chicago, Ill.

HOW TO SELL A GARGLE

...with a lively piece of "LUCITE"!



(Below)
Photograph shows tongue depressors made of molded "Lucite" after being removed from the die. Six of them are quickly and economically produced at one time with high luster and flawless body by the St. Louis Plastic Molding Co.



TO INCREASE the sales of Listerine antiseptic the Lambert Pharmacal Company set about to make America "throat-conscious." More "throat-conscious" people would mean more "gargle-conscious" people . . . and more gargling with Listerine!

But how to get people interested in their own throats? That was a problem . . . until someone remembered that transparent "Lucite" methyl methacrylate resin has the ability to transmit heatless light around curves. Why not let people *see* their own throats . . . with throat lights made of this versatile plastic? Then sell them in conjunction with the antiseptic.

Here was the answer. Made of clear "Lucite," the throat-light picks up light from a concealed bulb in the handle and flashes it clearly and sharply on throat, teeth or mouth. Moreover, because "Lucite" is so easy to mold, six of these transparent tongue depressors can be produced quickly and cheaply . . . at one injection stroke!

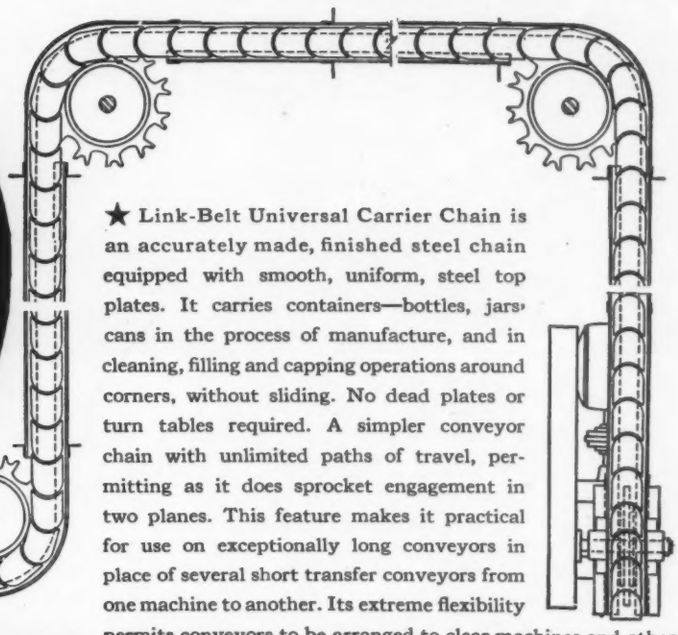
Now "Lucite" is lighting up thousands of throats . . . and more every day. Less than a month after these throat lights had been introduced, the Lambert Company had to *triple* the original production order for them. During the first 2 weeks after announcement to the trade—orders were booked for more than 1000 tons of Listerine, and sales are still increasing!

"Lucite" is just the thing to solve premium problems. It's strong . . . weather-resistant . . . easy-to-mold . . . clear . . . light . . . and it can be molded in a whole rainbow of colors. Specify "Lucite" for your own products . . . and take advantage of the Du Pont technical service to help solve your design or molding problems. For more information about "Lucite" and other Du Pont plastics, write to E. I. du Pont de Nemours & Co. (Inc.), Plastics Dept., Arlington, N. J.

DU PONT PLASTICS

A Conveyor Chain THAT OPERATES IN 2 PLANES

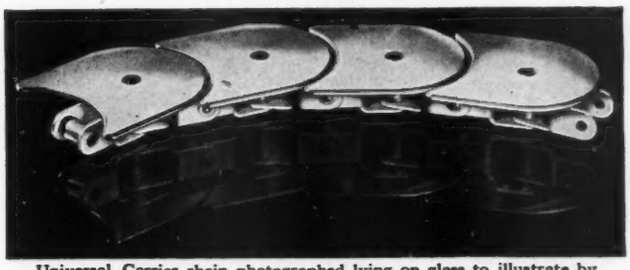
LINK-BELT
UNIVERSAL CARRIER CHAIN



★ Link-Belt Universal Carrier Chain is an accurately made, finished steel chain equipped with smooth, uniform, steel top plates. It carries containers—bottles, jars, cans in the process of manufacture, and in cleaning, filling and capping operations around corners, without sliding. No dead plates or turn tables required. A simpler conveyor chain with unlimited paths of travel, permitting as it does sprocket engagement in two planes. This feature makes it practical for use on exceptionally long conveyors in place of several short transfer conveyors from one machine to another. Its extreme flexibility permits conveyors to be arranged to clear machines and other obstructions, as it operates in rectangular, circular, semi-circular or irregular paths. Made in several standard sizes and in other metals to suit conditions.

Send for Folder PE 1637.

8331A



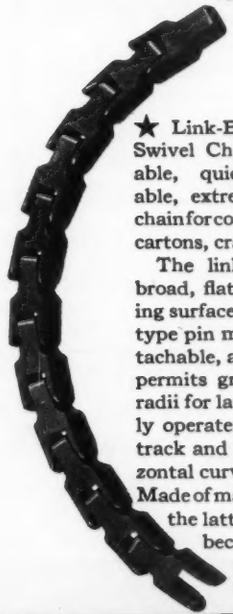
Universal Carrier chain photographed lying on glass to illustrate by reflection its underside.

LINK-BELT COMPANY

The Leading Manufacturer of
Equipment for Handling Materials and Transmitting Power

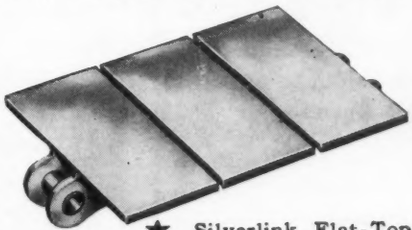
Indianapolis, Chicago, Philadelphia, Atlanta, Dallas, San Francisco, Toronto. Branch offices, warehouses and distributors in principal cities.

OTHER TYPES OF LINK-BELT CARRIER CHAINS

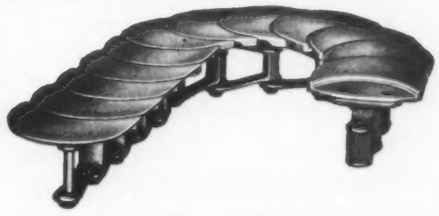


★ Link-Belt No. 4250 Swivel Chain is a durable, quickly detachable, extremely flexible chain for conveying cases, cartons, crates and cans.

The links provide a broad, flat, clean carrying surface. The cast ball and socket type pin makes the chain easily detachable, and the joint construction permits great flexibility and short radii for lateral curves. Chain usually operates in standard 2″ channel track and will operate around horizontal curves as small as 12″ radius. Made of malleable iron or PROMAL, the latter being usually preferred because of its longer life and resistance to corrosion. Send for Folder PE 1637.



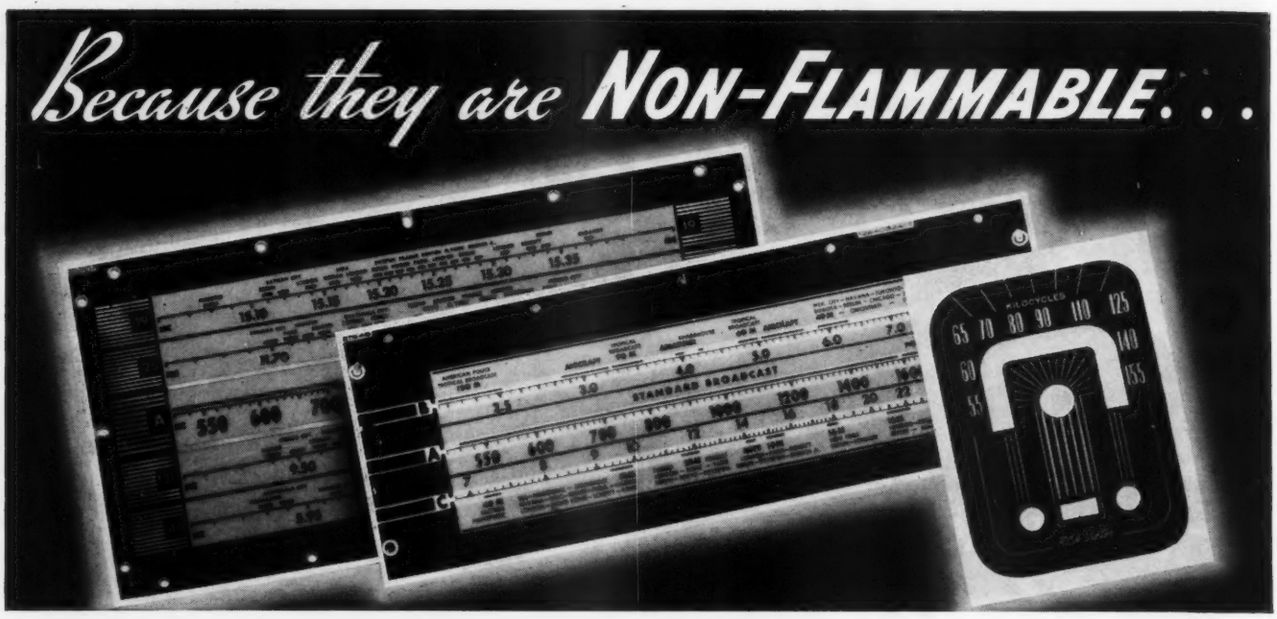
★ Silverlink Flat-Top Conveyor Chain is used for handling bottles, jars and cans through cleaning, filling and capping operations. For this service, the chain articulates freely and prevents "humping." Its light weight results in minimum power requirements and wear, and permits the return-run to hang unsupported without requiring excessive structural strength. Metal specifications may be selected for resistance to acid action or corrosion, and to withstand thorough cleaning during and after the day's run. Send for Folder PE 1637.



★ Link-Belt Crescent Conveyor Chain with attachments is cast or formed from ferrous or non-ferrous material, to make a continuous conveyor for handling bottles or other containers in a rectangular, circular, semi-circular or snake-like path. A conveyor employing this chain presents a practically unbroken surface, even at the turns. The bottoms of the attachments present good sliding surfaces for supporting guides.

Send for literature.

Because they are NON-FLAMMABLE. . .



Sillcocks-Miller uses "Vinylite" Plastic Sheets For Radio Dials

DELUXE radio dials are made by The Sillcocks-Miller Company, South Orange, New Jersey, from "Vinylite" plastic sheets. The dials are cut from sheet stock and printed in color. Some of them are over-laminated with paper-thin clear sheet under moderate heat and pressure to give lasting luster and protection to the printed surface. "Vinylite" resin sheets were chosen for this use because they are non-flammable . . . won't even support combustion, which helps assure listing by Underwriters' Laboratories, Inc. In addition, they hold their size and shape . . . won't shrink, expand, or warp. This simplifies handling, printing, and assembly.

These and the other unusual properties listed at the right are making "Vinylite" resin sheets preferred for an ever-increasing number and variety of uses. Send for a book of samples *now,* and let us help you determine where in *your* product these plastic sheets can be used profitably. Your request will not obligate you in any way.

Plastics Division
CARBIDE AND CARBON CHEMICALS CORPORATION
Unit of Union Carbide and Carbon Corporation
30 East 42nd Street UCC New York, N. Y.
PRODUCERS OF SYNTHETIC ORGANIC CHEMICALS

Only "Vinylite" Resin Sheets Have All These Properties

1. They do not curl, blush, or get sticky—water and moisture do not affect them.
2. They are non-flammable and will not support combustion.
3. They are completely resistant to oil, grease, and alcohol, and highly resistant to practically all chemicals.
4. They are exceptionally strong, tough, and rigid even at below-freezing temperatures.
5. They are tasteless, odorless, and non-toxic.
6. They can be easily formed, drawn, and laminated under heat.
7. They do not warp or shrink on aging—no "seasoning" period is necessary.
8. They can be printed on in multiple colors with perfect register.
9. They have and maintain uniform properties in all thicknesses.

Sheets available in quantity, in a variety of colors, thicknesses, and finishes.

Vinylite Resins *plastics for many purposes*

TRADE MARK

The word "Vinylite" is a registered trade-mark of Carbide and Carbon Chemicals Corporation.

SHEETS . . . FILM . . . ELASTIC SHEETING AND FILM . . . ADHESIVES
MOLDING POWDERS . . . SURFACE COATING RESINS . . . COATED PAPER

HOW ALLIS-CHALMERS MOTORS HELP YOU SELL!

Here's An Easy Way to Find Out! Get the Facts on Allis-Chalmers Lo-Maintenance Motors . . . How They Improve the Performance of Your Machines . . . Add to Their Sales Appeal!

IT'S EASIER TO SELL YOUR EQUIPment when it's powered by motors that have customer-acceptance. On this Newton Rotary Miller, an Allis-Chalmers Lo-Maintenance Motor not only provides low-cost, dependable performance . . . but has sales-bringing customer-acceptance as well!

IN THE EYES of your customers — your machines are only as good as the motors that power them!

That's why so many leading machine designers today are specifying Allis-Chalmers Lo-Maintenance Motors for *their* machines. They know that with these motors they not only provide better machine operation . . . they get the added dividends of customer satisfaction . . . greater percentage of repeat business . . . more sales!

There's a reason for all this — and that reason is "full-measure" construction!

Lo-Maintenance Features Are Selling Features!

In Allis-Chalmers Lo-Maintenance Motors you get such first-class selling points as — distortionless, twistless stator . . . indestructible, removable rotor . . . high carbon steel frame . . . no skimping anywhere . . . *plus* remarkable records for standing up under severe conditions that often wreck ordinary motors.

These are important features . . . extra-value features that really count with your customers. They are features that will help you in selling your own equipment.

Get in touch with the engineer in the Allis-Chalmers district office near you for the complete story on Lo-Maintenance Motors. Or write Allis-Chalmers, Milwaukee, Wisconsin.

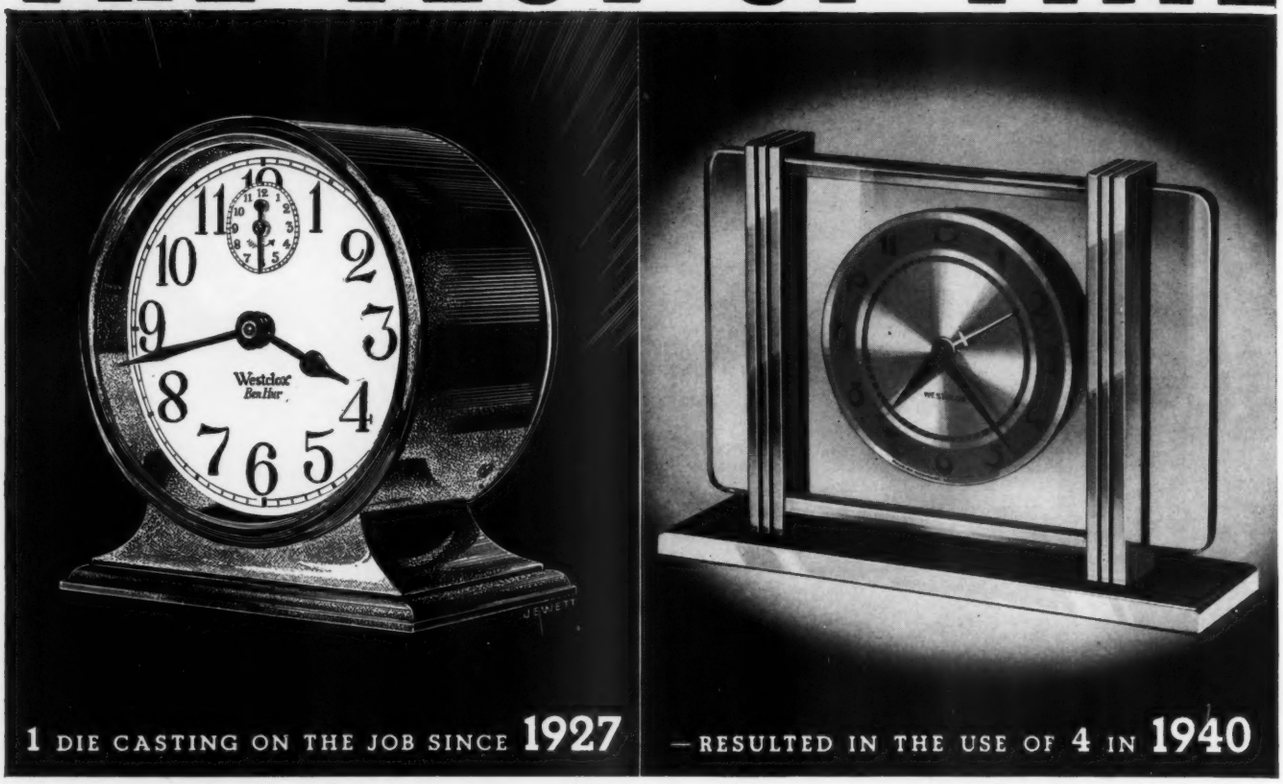
A 1323

Over 90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

THE TEST OF TIME



—KEEPS DIE CASTINGS ON THE JOB

The first use of ZINC Alloy Die Castings by a product designer is often prompted by an effort to lower manufacturing costs. It is the test of time, however, that keeps die castings on the job and sets the designer to finding other parts that can be converted.

A highly regarded clock manufacturer, for example, employed a ZINC Alloy Die Casting for the first time in 1927 — as the base on the clock shown at the left. The experience gained with this application resulted in a wider use of die castings on all succeeding models. The latest clock produced by this manufacturer has 4 ZINC Alloy Die Castings, including the base, bezel, and side posts — just about all the parts that could be die cast.

Your manufacturing problems may be far removed from those of a producer of clocks, but this is only one among hundreds of similar case histories of die casting acceptance in widely varied fields. If *you* are not thoroughly informed on the physical and economic advantages offered with ZINC Alloy Die Castings, we suggest that you consult a commercial die caster — or write to The New Jersey Zinc Company, 160 Front Street, New York City.

This advertisement is the ninth of a series. Copies of those preceding gladly mailed on request.

The Research was done, the Alloys were developed, and most Die Castings are made with

HORSE HEAD SPECIAL (99.99+% Uniform Quality) ZINC

VIBRATION *can be isolated*

THIS SMALL SHEAR TYPE BONDED RUBBER MOUNTING* WILL INCREASE THE EFFICIENCY OF YOUR EQUIPMENT BY ABSORBING SHOCK AND VIBRATION; AND WILL PREVENT ITS TRANSFER TO OR FROM SURROUNDING MACHINERY...

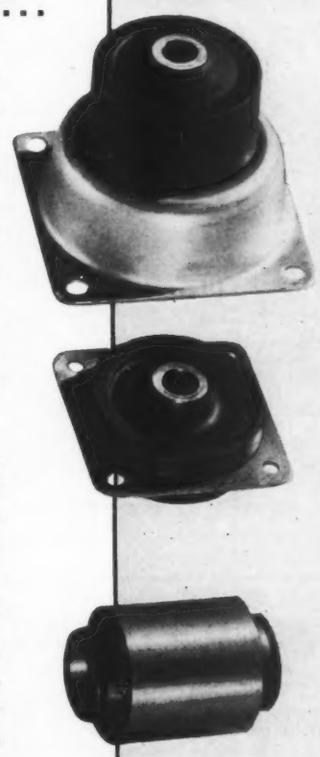
WHEN properly designed into a piece of equipment, Lord Shear Type Mountings will localize and isolate destructive vibration and reduce stress and fatigue to a minimum.

The effectiveness of these mountings is based on the fact that rubber when stressed in shear deflects more readily than when under direct tension or compression. In applying this principle Lord has perfected and patented many varieties of bonded shear type rubber mountings that provide unusual radial stability and axial elasticity.

Lord Bonded Rubber Mountings will work wonders in removing this one basic cause of inefficient operation or outright failure due to fatigue. This result can be obtained regardless of the size and weight of your equipment, or the frequencies of the disturbing vibrations.

Our Engineering Department has solved thousands of vibration problems in connection with the correct design of practically every type of equipment. This extensive knowledge of vibration engineering is available for finding the correct answer to your particular design problem.

Lord Manufacturing Co., Erie, Pa.



LORD PLATE FORM SHEAR TYPE MOUNTINGS are made with square, diamond or round outer plates or in stamped holders. The center tube is at right angles to the outer plate, and the two metal parts are bonded to the isolating rubber body. Lord Plate Form Mountings can be used singly or in series for suspension of instrument panels, electrical equipment, radios, motors, fans, etc. that must be isolated against receiving or transmitting vibration and shock. Load range is from ½ to 300 pounds.

LORD TUBE FORM SHEAR TYPE MOUNTINGS consist of two metal tubes bonded in concentric position to rubber. Loads are carried and vibration is absorbed axially. This design permits loads up to 1500 lbs. Tube Form Mountings are used for equipment when exceptional radial stability is required, such as internal combustion engines, motors, compressors, machinery, etc.

*OR ANY ONE OF THE 1,000 DIFFERENT STYLES MADE

BRANCH OFFICES
923 Fairmount Rd.
Burbank, Calif.

BONDED RUBBER JOINTS

LORD
BONDED RUBBER

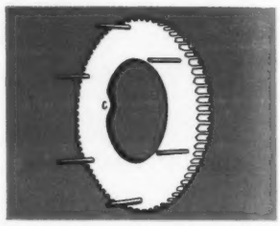
SHEAR TYPE RUBBER MOUNTINGS

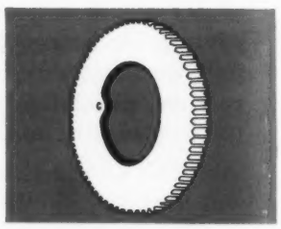
280 Madison Ave
New York City
332 S. Michigan Ave.
Chicago, Ill.

It takes rubber in shear to absorb vibration

Helping solve the *Tough* problems . . .

Meehanite Clutch Plates in AJAX Air Clutch Forging Machines





The Ajax Manufacturing Company, Cleveland, Ohio, first introduced the air clutch to the forging machine field. Hailed as an outstanding contribution to the forging industry, the air clutch presented a truly "tough" problem, a problem of successful design being realized in the best materials for the job.

Meehanite driving plates contribute their *superior strength, wear resistance,* and *dependability* to the clutch; make up the driving medium which transmits energy from the driving wheel to the machine during the work cycle. In parts like these any possibility of hidden weaknesses, internal distorting stresses, or structural defects could not be tolerated. Meehanite foundries, using the Meehanite processes, can eliminate the "unforeseen contingencies" you are used to considering and provide you with better castings, more security, less worry.

YOU CAN SOLVE *YOUR* TOUGH PROBLEMS WITH MEEHANITE

Meehanite Research Institute

311 ROSS STREET PITTSBURGH, PA.

There is a Meehanite Foundry near you!

Ansonia, Conn.	Farrel-Birmingham Co., Inc.
Bethayres, Pa.	H. W. Butterworth & Sons Co.
Bridgewater, Mass.	The Henry Perkins Co.
Buffalo, N. Y.	Pohlman Foundry Co., Inc.
Charleston, W. Va.	Kanawha Manufacturing Co.
Chattanooga, Tenn.	Ross-Meehan Foundries
Chicago, Ill.	Greenlee Foundry Company
Cincinnati, Ohio	Cincinnati Grinders Incorporated
Cincinnati, Ohio	The Cincinnati Milling Machine Co.
Cleveland, Ohio	Fulton Foundry & Machine Co.
Denver, Colo.	The Stearns-Roger Mfg. Co.
Detroit, Mich.	Atlas Foundry Co.
Flint, Mich.	General Foundry & Mfg. Company
Hamilton, Ohio	Hamilton Foundry & Machine Co.
Irvington, N. J.	Barnett Foundry & Machine Co.
Los Angeles, Calif.	Kinney Iron Works
Milwaukee, Wis.	Koehring Company
Mt. Vernon, Ohio, Grove City, Pa.	Cooper-Bessemer Corporation
New York, N. Y.	The American Brake Shoe & Foundry Co.
Oakland, Calif.	Vulcan Foundry Company
Orillia, Canada	E. Long, Ltd.
Philadelphia, Pa.	Florence Pipe Foundry & Machine Co., (R. D. Wood Company, Selling Agents)
Phillipsburg, N. J.	Warren Foundry & Pipe Corp.
Pittsburgh, Pa.	Meehanite Metal Corporation
Pittsburgh, Pa.	Rosedale Foundry & Machine Co.
Rochester, N. Y.	American Laundry Machinery Co.
St. Louis, Mo.	Banner Iron Works
St. Paul, Minn.	Valley Iron Works
London, Eng.	The International Meehanite Metal Co., Ltd.
Waterloo, N. S. W.	Australian Meehanite Metal Co., Ltd.

Something NEW

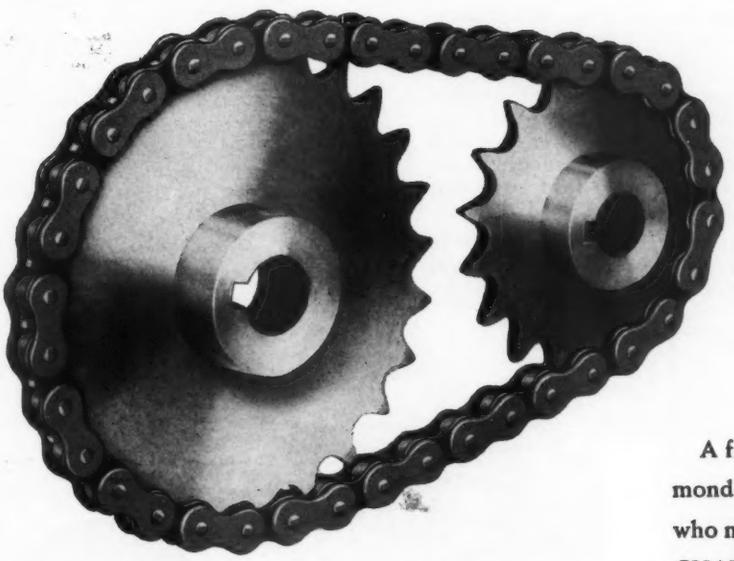
A Smaller, Lighter Weight Roller Chain
0.315 in., (8mm) Pitch

Actual Size—*192 INDIVIDUAL PARTS IN TWELVE INCHES OF CHAIN*

SPECIFICATIONS

Pitch	**—0.315 in. (8 mm)**	**Pin Diameter**	**—0.0905 in.**
Roller Diameter	**—0.197 in.**	**Weight per foot**	**— 1.75 ounces**
Inside Width	**—0.125 in.**	**Tensile Strength**	**— 1100 lbs.**

A featherweight—twelve inches weighing only 1¾ ounces, one link only .0459 ounces—this sturdy little chain will transmit power quietly and smoothly, at still higher speeds than the larger sizes of standard Diamond Roller Chains, —⅜" to 2½" pitch inclusive—with the same high efficiency and the same sure, non-slip, non-creep advantages.



Full size picture of 1½:1 reduction drive on 2.56" centers. Capacity of this drive:— ½ h.p. at 1800 r.p.m. • 1 h.p. at 3600 r.p.m.

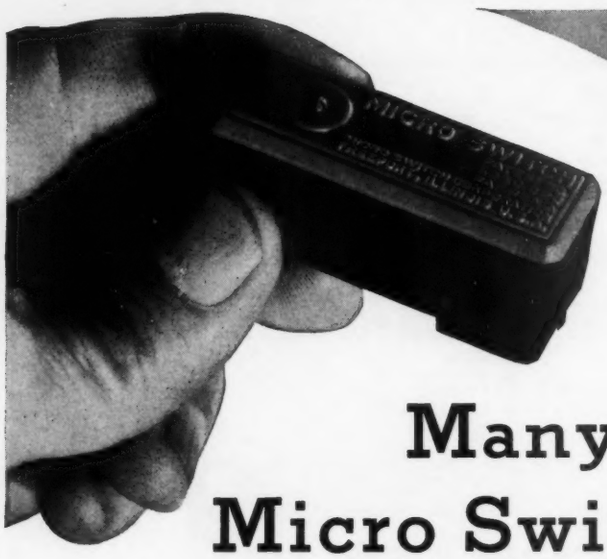
The wide range of utility of Diamond Roller Chain Drives is still further extended by this new chain. All the advantages of Diamond Roller Chain Drives are provided in a still smaller "package"—more compact, lighter in weight, extremely short shaft centers.

Fifty years of specializing in the manufacture of one product—Diamond Roller Chain Drives—have made it possible to build the same quality and endurance into this extremely small chain that are characteristic of the larger sizes. "Built like a watch" is not just an idle statement—the 192 individual parts in one foot of chain are made with such accuracy that the total length tolerance is plus .0156 minus .000".

A free sample of this new lightweight and smaller Diamond Roller Chain (Model No. 88) will be sent to those who may be interested in its possibilities . . . DIAMOND CHAIN & MFG. CO., 443 Kentucky Avenue, Indianapolis, Indiana. Offices and Distributors in All Principal Cities.

DIAMOND **ROLLER CHAINS**

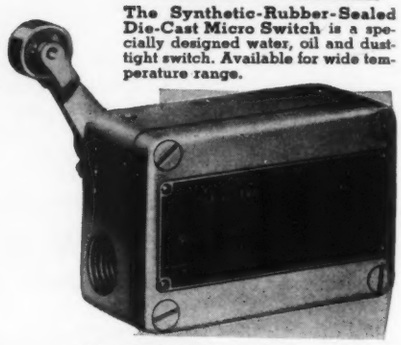
50TH ANNIVERSARY • 1890-1940



The Roller-Actuated Micro Switch is widely used as a precision limit switch in the machine tool and packaging industries.

Many Micro Switches To Fit Many Jobs

The Synthetic-Rubber-Sealed Die-Cast Micro Switch is a specially designed water, oil and dust-tight switch. Available for wide temperature range.



The Explosion Proof Micro Switch is small—only 18 cubic inches. It is a single pole, double throw switch, listed by Underwriters' for hazardous locations, Class I Group C and D, Class II Group G.

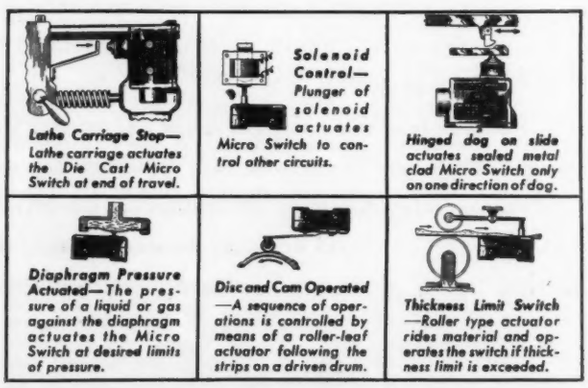
BASIC Micro Switch characteristics are varied to meet industrial needs and combine with metal housings and actuators into over 400 separate styles.

The Basic Micro Switch is a small, precise snap-action switch enclosed in an Underwriters' Listed plastic housing. It weighs less than one ounce, requires energy ranging from only .004 to .0003 ounce inches, depending on type of switch desired, and will operate 300 times per minute for as high as ten-million trouble-free operations. Underwriters' rate it at 1200 watts up to 600 volts, A.C.

The name "Micro Switch", therefore, indicates more than a small bakelite-enclosed switch . . . It identifies a line of switches designed for broad application in industry.

The Micro Switches shown here, and others not shown, are now widely used in the machine tool industry, in aircraft, in instruments, in thermostats, in commercial phonographs, in the process industries—in hundreds of other products and places where time, temperature, pressure, weight, relays or solenoids are part of control. The sketches shown below suggest the countless applications of Micro Switches.

Micro Switch engineers are specialists in precision switching. Ask for their suggestions as to the application of Micro Switches to your design problems. Data sheets covering the above switches are available.



Lathe Carriage Stop—*Lathe carriage actuates the Die Cast Micro Switch at end of travel.*

Solenoid Control—*Plunger of solenoid actuates Micro Switch to control other circuits.*

Hinged dog on slide *actuates sealed metal clad Micro Switch only on one direction of dog.*

Diaphragm Pressure Actuated—*The pressure of a liquid or gas against the diaphragm actuates the Micro Switch at desired limits of pressure.*

Disc and Cam Operated *—A sequence of operations is controlled by means of a roller-leaf actuator following the strips on a driven drum.*

Thickness Limit Switch *—Roller type actuator rides material and operates the switch if thickness limit is exceeded.*

The Micro Air Switch is a special, light weight, aluminum, all purpose switch designed for aircraft applications.

The Roller-Plunger Die Cast Micro Switch is a limit type switch with roller adjustable to longitudinal or cross-wise position.

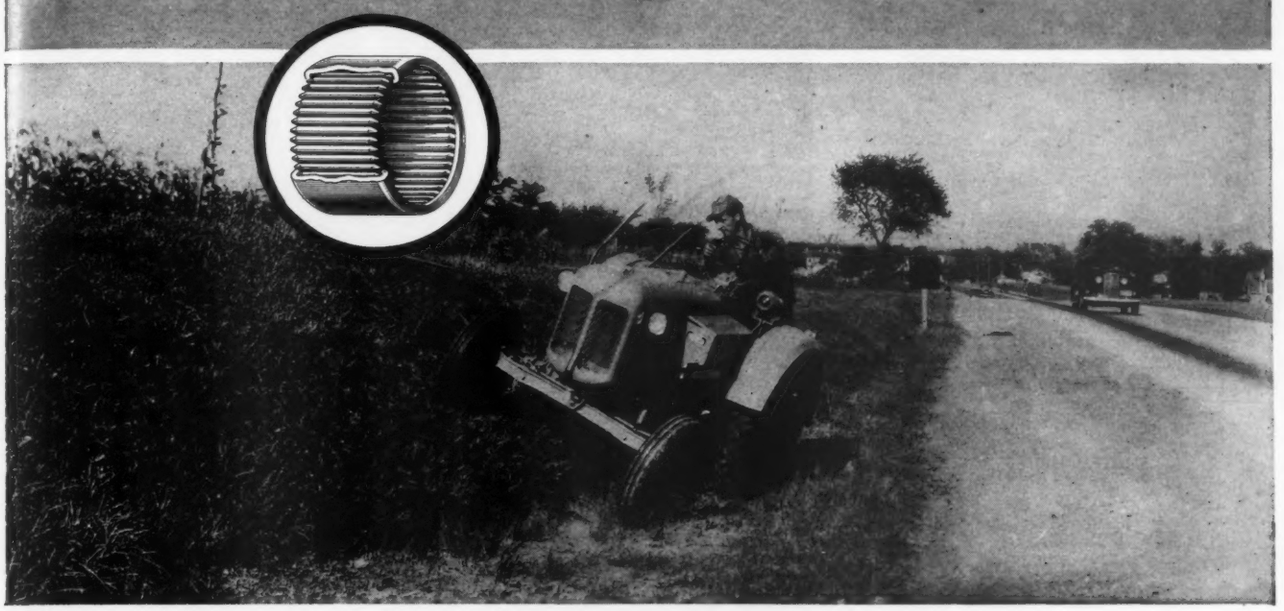
MICRO SWITCH is the Name of a Particular Product Not a General Term.

Copyright 1940, Micro Switch Corporation

TRADE MICRO MS MARK SWITCH

Manufactured in FREEPORT, Illinois, by Micro Switch Corporation. Sales Offices: New York, Chicago, Boston

"TORRINGTON NEEDLE BEARINGS TAKE HEAVY ROTATING AND OSCILLATING LOADS EFFECTIVELY" IN CENTAUR HI-WAY MOWER



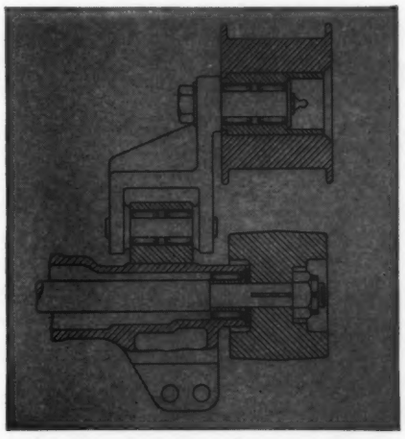
Eleven applications of the Needle Bearing help to reduce friction, increase operating efficiency and add to the service-life of this Model KM Centaur Hi-Way Mower.

SWAYING and lurching up-ditch, down-ditch, over slopes, fills and embankments—and most of the time at an acute angle—the popular Centaur Hi-Way Mower plies its job of keeping road-borders clear of weeds and other unsightly growths that mar the beauty and impair the safety of modern highways.

As can be appreciated, such rough and tumble service imposes severe strain on every component part of this motorized mowing unit. Therefore, the long service-life of the Model KM Centaur is adequate testimony to the skilled engineering construction with which it is built, and the care with which integral parts are selected.

The Torrington Needle Bearing is no exception to this rule. According to Mr. E. A. Cross, Superintendent of the Centaur Corporation, "The Needle Bearing was selected because it is economical in cost, simple to install, requires minimum space in cramped locations, retains lubrication well, and withstands heavy rotating and oscillating loads effectively.

"All told," adds Mr. Cross, "eleven applications of Torrington Needle Bearings are used on Centaur KM and RW mowing equipment. In three applications of the Needle Bearing, Torrington inner races* are used as 'bushings' to withstand heavy oscillating shock loads and have proved very efficient."



Typical of these applications is the mower drive shaft, belt tightener, pulley and bracket which illustrates the compact design permitted by Torrington Needle Bearings.

When any manufacturer selects the Needle Bearing for as many of its features as has the Centaur Corporation, there is very little that we can add. Except, perhaps, to stress its ready adaptability to product design, which frequently results in marked savings in weight, space and cost. That, plus the suggestion that *you* translate these remarkable manufacturing and operating advantages into terms of *your* product, to appreciate why so many leading manufacturers have adopted this revolutionary anti-friction development.

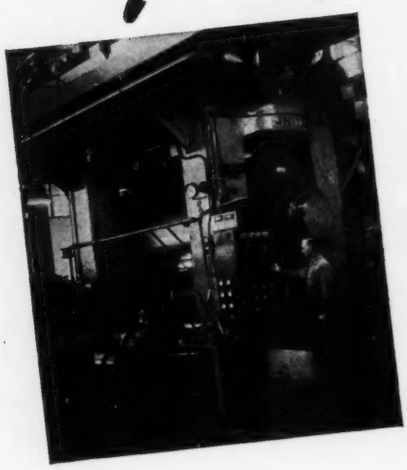
For further information write for Catalog No. 8. For Needle Bearings to be used in heavier service, request Booklet 103X from our associate, the Bantam Bearings Corporation, South Bend, Ind.

*Where a hardened shaft is not feasible, a Torrington hardened inner race can be supplied.

The Torrington Company
ESTABLISHED 1866
Torrington, Conn., U.S.A.
Makers of Needle and Ball Bearings
New York Boston Philadelphia Detroit
Cleveland Chicago London, England

TORRINGTON
NEEDLE BEARING

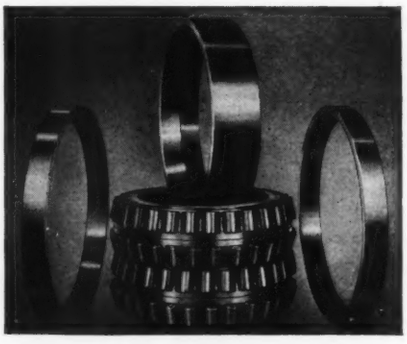
Record run



(*Above*) On the work rolls of this cold strip mill, Bantam Straight Roller Bearings (13" I.D., 17¼" O.D., 10" long) are used.

(*Above*) Both work rolls, and back-up rolls of this continuous hot strip mill use Bantam 4-row Tapered Roller Bearings.

NEW TONNAGE PEAK SET WITH BANTAM-BEARING-EQUIPPED ROLLS



(*Right*) A single large 4-row tapered roller bearing designed by Bantam for heavy duty mill service. Bantam has made many of the largest bearings ever built.

ALL-TIME tonnage high for an 8-hour run on a continuous cold strip mill was the record recently established at the plant of one of the country's leading steel producers. And the work rolls of the mills on which this record run was made are equipped with Bantam Bearings.

This is but one of the places in this modern plant where Bantam Bearings are helping to set new standards of steel mill performance. On the continuous hot strip mill are 4-row Tapered Roller Bearings also designed and built by Bantam. Bearings with a 35½" O. D. and 18" long are used on the back-up rolls of this mill. Work rolls are also equipped with Bantam Bearings of the same type, measuring 13" I.D., 17¼" O.D., 10" long.

These bearings are a typical illustration of Bantam's ability to meet unusual requirements with anti-friction bearings. Straight roller, tapered roller, or ball bearings—Bantam makes them all—is ready to supply the size and type needed for any service requirement. And the comprehensiveness of Bantam's line of bearings gives added value to Bantam's engineering counsel. With a background of years of experience in the design, manufacture, and application of every bearing type, Bantam engineers give unbiased, authoritative advice on bearing selection. For bearings that will give long, low-maintenance service under the severest conditions—TURN TO BANTAM.

BANTAM BEARINGS CORPORATION • SOUTH BEND, INDIANA

BANTAM BEARINGS

STRAIGHT ROLLER • TAPERED ROLLER • NEEDLE • BALL

Let us help you with your

Emergency

When increased production schedules begin to overtax the facilities of your plant . . . call in a Johnson Engineer. Perhaps we can show you an easier, more satisfactory way of securing and installing your bearing requirements. Then too, we may be able to show you how to convert equipment . . . now used in the production of bronze parts . . . to more profitable uses. Or we may be able to offer worthwhile suggestions on rehabilitating old equipment. At any rate, we will gladly match our time against yours in solving your bearing problems. All of our recommendations will be based strictly on facts . . . free from all prejudice . . . supported by more than thirty years exclusive bearing experience. Your inquiry carries no obligation.

JOHNSON BRONZE
508 SOUTH MILL STREET
NEW CASTLE, PA.

The most complete **SLEEVE BEARING SERVICE** *in the world*

All These and Heaven, Too

ONE definition of the word "heaven" is: "Any place of great comfort". Hence, comparatively speaking at least, a plant which operates year in and year out free from motor failures is "heaven" when it is compared to one which is frequently shut down for motor repairs.

Crocker-Wheeler is able to offer you a complete line of polyphase alternating-current motors, all types and all sizes from ¼ to 10,000 horsepower —"and Heaven, Too"—because Crocker-Wheeler motors help to prevent costly shut-downs. They are motors that can be installed and then forgotten.

Write today for your copy of the new 6-page *Motor Price List*, which gives prices, weights and dimensions of standard motors in sizes up to 75 horsepower.

CROCKER-WHEELER

CROCKER-WHEELER ELECTRIC MFG. CO., AMPERE, NEW JERSEY

Sales Offices in Principal Cities

Products: Polyphase Induction Motors, Synchronous Motors, Direct-current Motors, Alternating-current Generators, Direct-current Generators, Motor-Generator Sets, Flexible Couplings.

THE TEST OF SATISFACTION IN ELECTRICAL CONTACTS AS WELL AS SHOES . . .

Which will fit **YOU** *best?*

When Mallory makes a contact recommendation you can be sure that it will "fit" because it has been based wholly on these two vital factors.

1. Experience of years of specialization.
2. Painstaking study of the specific problem, backed by a succession of exhaustive laboratory and service tests.

Mallory's recommendations are unbiased because Mallory manufactures every type of contact. Solid rivets, silver-faced base metal-backed types (domed and flat) with rivets, projection backs that facilitate welding, or solder-flushed backs for spot soldering, screw types (with contact on either head end or screw end) and many special designs.

Mallory also manufactures a complete line of contactor materials for circuit breakers operating in air and oil —for heavy, medium and ordinary duty—where the contact material must (1) break the arc only; (2) carry the current and act as arcing tip.

In addition Mallory makes a complete line of inlay and overlay bi-metals for users of electrical contacts, and for instrument builders, laboratories and chemical industries employing bi-metals because of their resistance to corrosion. Wherever it is desirable to combine the qualities of two different metals, Mallory can help you.

Write today for the Mallory Engineering Data Book on Electrical Contacts—or submit your contact problems to Mallory engineers for recommendation of the material best suited to your needs.

P. R. MALLORY & CO., Inc.
INDIANAPOLIS INDIANA
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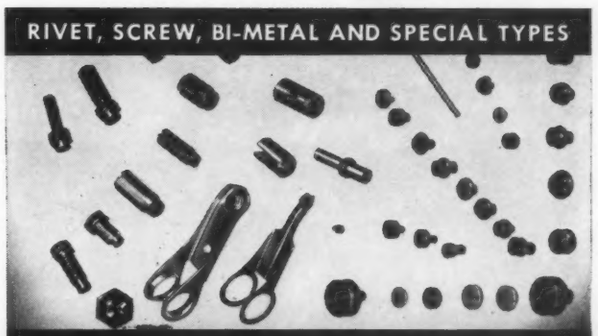

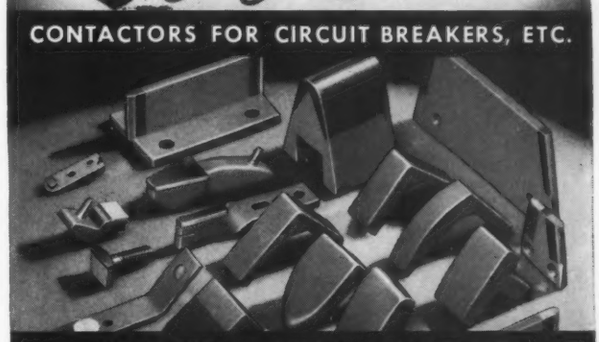

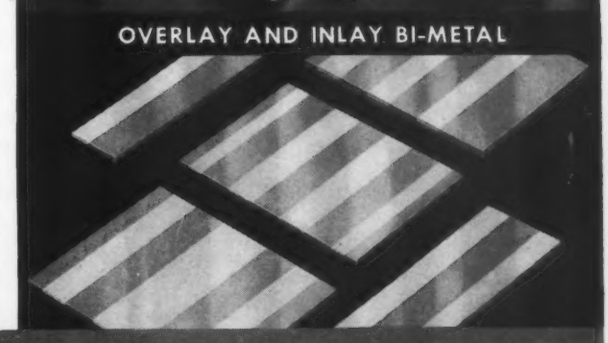

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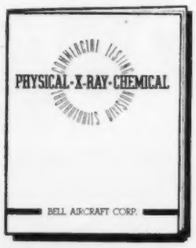
QUESTIONS IN TESTING
make this FREE BOOK important to YOU



An aircraft manufacturer opens its

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to other industries

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Today national urgency as well as sound industrial practice requires that manufacturers *know* their products *in advance.* "Should" has become "must" in meeting service conditions. To meet the new demand for complete, up-to-the-minute industrial testing facilities, the Bell Aircraft Corporation, conveniently located in Buffalo, offers its Commercial Testing Laboratories with aircraft standards of accuracy. We'd like to send you, free of charge, a booklet on the latest developments in the technic of testing. It may suggest to you, as it has to many others, a means of making your products more easily, or at less cost, or better. Use the convenient coupon below.

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THAT SURPRISED EVEN ITS DESIGNERS

OFFERS 4 DEFINITE BENEFITS TO USERS

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You can enjoy these benefits. Write Dept. A for information.

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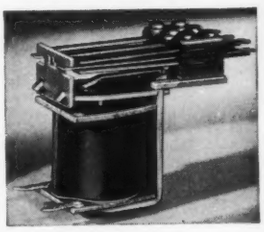
Tell us (1) Your product or operation (2) Function and performance details (3) Whether chief objective is improved performance or reduced cost. We'll send a helpful recommendation, free. Write Dept. A.



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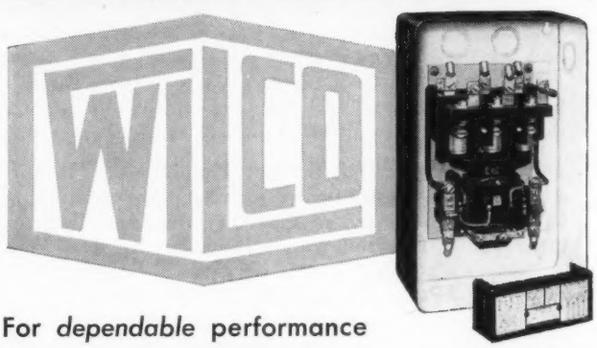

For *dependable* performance

ALLEN-BRADLEY chooses WILCO

It just doesn't pay to take chances with quality. And Allen-Bradley, famous manufacturer of motor controls proves it by using cadmium silver electrical contacts as manufactured for them exclusively by Wilco!

Pioneer in the development, manufacture and sale of electrical contacts and thermometals, Wilco is the preferred name in temperature control in any industry you can name. Take full advantage of Wilco's experience and research leadership in both of these highly specialized fields. Outline your particular problem and write Wilco *today!*

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PLATINUM . . . SILVER . . . SPECIAL ALLOYS . . . TUNGSTEN

Speaking of ENDURANCE

There are thousands of good distance swimmers . . . for every one who is truly great. When others quit from fatigue, the great one is just getting his "second wind." Just so, the extra "power hours" built into Dumore motors lift them far above the field when precision and endurance qualities, not price alone, are prerequisites. Dumore applications range from powering foolproof aircraft controls to the finest of surgical devices. What are your exacting power requirements? The consultation of Dumore engineers is yours without obligation. Write for facts and the brochure, "Speaking of Endurance."

THE DUMORE COMPANY, Dept. 330-M RACINE, WIS.

SPECIFICATIONS TYPE "EL" MOTOR

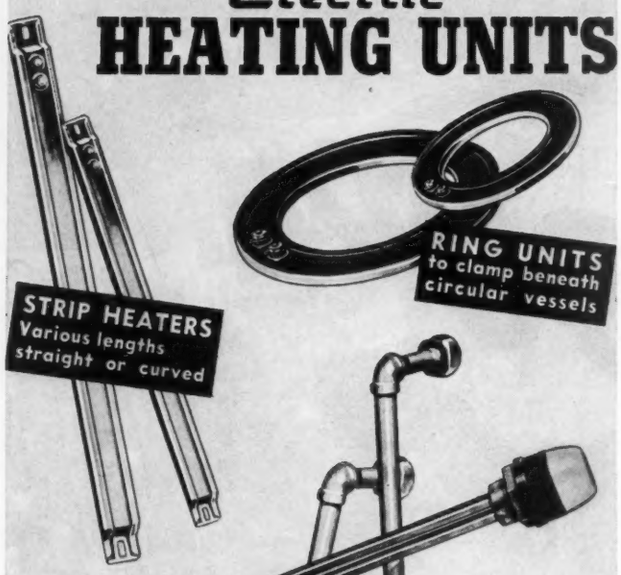
Series Universal Motor; 0-60 cycles; H. P. range, 1/40-1/66; full-load speeds 200-3000 r. p. m.; amperes (115 V.) .5; watts input, 62; duty, 30 minutes; temperature rise 40°C; cooling, internal fan; bearings, composition bronze; motor housing, die-cast aluminum; weight 1 lb. 15 oz.

Dumore Motors

FOR EXTRA POWER HOURS

One of these units may give your product
√ IMPROVED DESIGN
√ BETTER PERFORMANCE
√ GREATER SALEABILITY
Why not check?

CHROMALOX
Electric HEATING UNITS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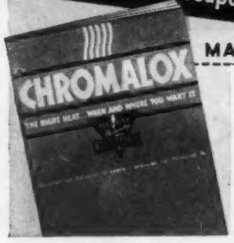

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EDWIN L. WIEGAND COMPANY
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Name.....

Position.....12

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RBM Circuit Breakers"

R-B-M MANUFACTURING CO. LOGANSPORT, INDIANA

THESE circuit breakers provide a definite overload protection for electrical circuits where the demands of such circuits are subjected to varying conditions . . . owing to its adaptability, bimetal is used as the active element to automatically produce the necessary motion. If your product calls for automatic movement at certain temperatures, then specify Chace Thermostatic Bimetal as the active element of your control . . . always dependable.

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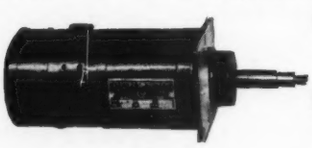

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TORQUE MOTORS
ENHANCE
DEPENDABILITY

WHEN MADE A PART OF YOUR MACHINE, BY PROVIDING SIMPLE RUGGED CONSTRUCTION.

ASK A USER OF
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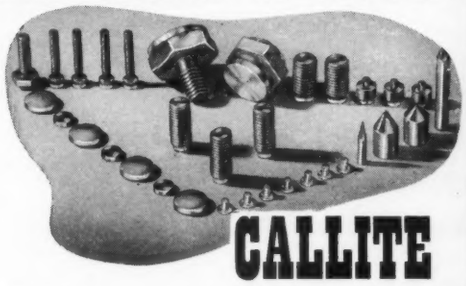
ONE SOURCE OF SUPPLY



CALLITE

Solves the Contact Problem

Whether stock or special contacts are required, Callite can supply them if they are of tungsten, molybdenum, silver, platinum, palladium, or special alloys. Moreover, Callite engineers are ready to cooperate with manufacturers on special contact problems involving unusual operating requirements. Long years of specialization in this field enable Callite-Tungsten to supply any and all of your contact requirements—economically, dependably and quickly. It pays to contact Callite for contacts. Catalog and samples on request.

Callite contacts are available in
TUNGSTEN, MOLYBDENUM, SILVER, PLATINUM, PALLADIUM AND IN ALLOY COMBINATIONS OF THESE METALS.

CALLITE TUNGSTEN
CORPORATION
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LIFE
1,000,000
YEARS?

FLAMENOL
Reg. U. S. Pat. Off.
WIRE

TENSILE STRENGTH in Lb per Sq In.		
Original	96 Hours in Oxygen Bomb	504 Hours in Oxygen Bomb
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AS IF anything could have a life of 1,000,000 years! And we're making no such fantastic promise. But the point is that Flamenol contains *nothing* that will oxidize; there is no reason why it should deteriorate with age.

Tests indicate that this is true. After accelerated aging in the oxygen bomb, at 300 pounds per square inch for 504 hours at 70 C, Flamenol shows no sign of depreciation in tensile strength.

The results of recent tests in oil are even more remarkable. A G-E cable specialist will be glad to go over the detailed data with you. Ask him, too, about the reduced thickness of insulation on certain sizes and the new low prices. General Electric Company, Schenectady, N. Y.

GENERAL ELECTRIC

WHY You Should Use "TAILORED" MOTOR PARTS in Your Devices

Ratings from 1/100 hp to 1 1/3 hp at speeds from 5,000 to 10,000 rpm, for either alternating current or direct current up to 250 volts.

"TAILORED" series-motor parts give you and your customers the benefits of parts that have been designed to meet both the mechanical and electrical requirements of your devices. This proper fitting of motor parts results in satisfactory motor operation and long life—features that you will like to have associated with your products.

General Electric series-motor parts are specially designed and manufactured to give them the correct characteristics for your applications. High-quality materials, correct design, special processes, and expert workmanship are all combined to give the motor performance that you want your customers to enjoy.

Decrease Size and Weight with G-E Parts

The use of series-motor parts minimizes both size and weight of a unit because the housing and end shields are part of the complete device. Moreover, large outputs are obtained from physically small motors. Why not get G-E series-motor parts for your devices? These carefully built and carefully tested parts are available in the following types:

NORMAL-SERVICE PARTS

For high-speed applications where duty is intermittent, where constant speed is not required, and where the load is fairly constant; for example, domestic mixers, vacuum cleaners, and similar devices that limit light-load speed and do not operate without load.

HEAVY-DUTY PARTS

For tools, such as drills and saws, where speeds are high and overloads may be severe for short periods. They are built for unusual service conditions—windings are moisture-resistant and firmly bonded to withstand high speeds.

COMPENSATED PARTS

For devices requiring better speed regulation, greater starting torque, and greater output than can be obtained with heavy-duty parts. They differ from the latter in the construction of the field coils.

G-E engineers will be glad to help you select the correct parts for your application and in designing your device so that adequate ventilation is obtained for the motor. For information, call the nearest G-E office, or address General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

700-17

AUTOMATIC · · · EFFORTLESS · · · SPEEDY

PHOTOELECTRIC CONTROL

AT NEW LOW PRICE

$28.15 COMPLETE*
RELAY ALONE $19.50

THIS NEW PHOTOELECTRIC RELAY opens new possibilities for control by means of the "electric eye." Despite its sensational low price, it is an exceptionally durable, long-lived control. Its novel enclosure makes it remarkably easy to install. And because of its attractive, streamlined styling, it will fit in pleasingly wherever it may be located.

Whether you're interested in photoelectric control for your plant processes or for use on the equipment you manufacture, you'll find this new relay worth looking into.

*Includes relay and light source, as shown, plus transformer

USE IT FOR

- limiting travel
- protecting workers
- automatic weighing
- inspecting packages
- control of machines
- counting production
- experimental projects
- laboratory experiments
- sorting objects by size

General Electric Co., Section B 676-27
Schenectady, N. Y.

Please send me literature on your new CR7505-K100 photoelectric relay explaining what it can do for me and listing the many combinations available.

Name .....

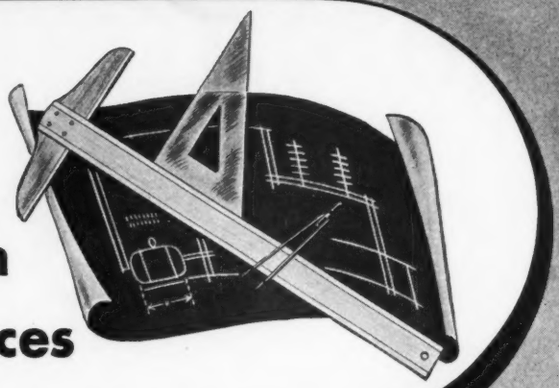
Address ..... *State* .....

City .....

GENERAL ELECTRIC

WAGNER MOTORS

are designed to harmonize with modern machinery and appliances

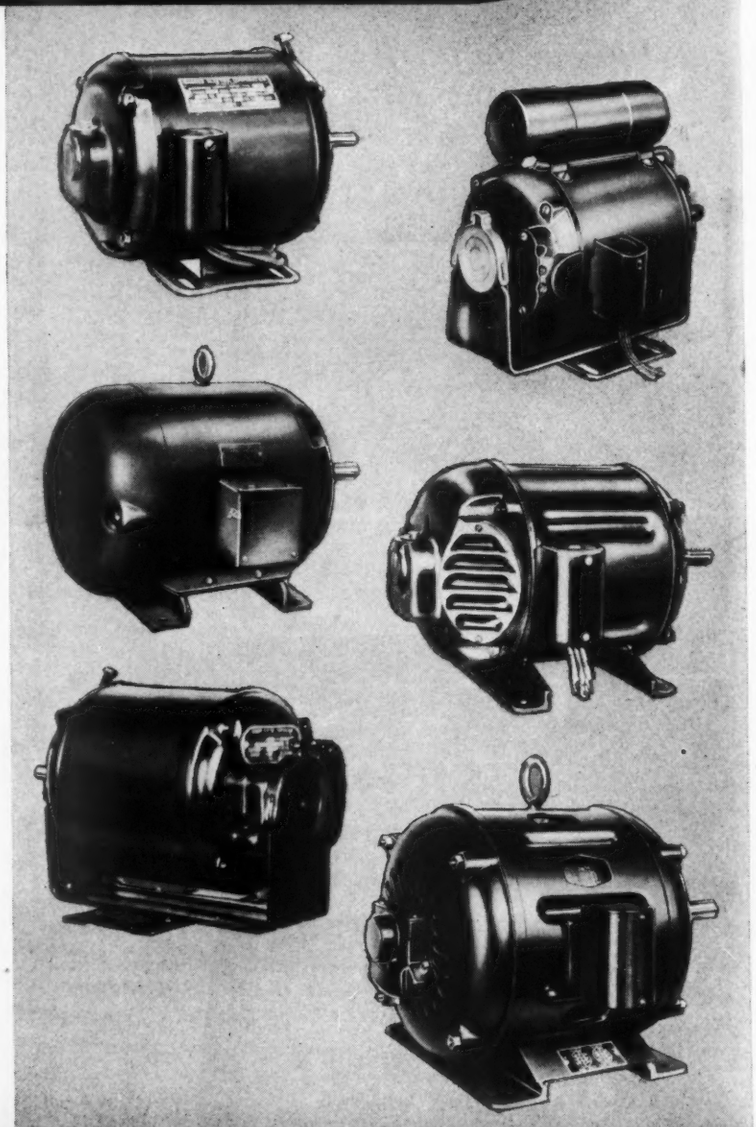


THE modern trend is toward neater, more compact machinery. Sometimes the motor presents a problem in the streamlining of machinery, but not where Wagner motors are used, for Wagner motors are designed to harmonize with the most modern machinery and appliances. No longer must the motor be an unsightly appendage on an otherwise modern piece of equipment. Wagner motors are designed for compactness and neat appearance. They seemingly become an integral part of the equipment which they operate.

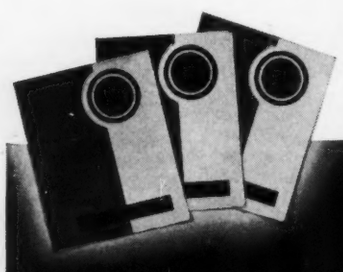
Appearance is only one reason why more and more manufacturers are selecting Wagner motors for their modernized equipment. There are other reasons too. Wagner motors are sturdy and reliable. Their record for performance and dependability is your assurance that they will give the kind of service you want your equipment to give. Wagner motors are so diversified in types and ratings that you can select the motor that exactly meets the electrical and mechanical requirements of each particular machine.

Wagner maintains twenty-five sales and service branches located throughout the United States. Each branch carries a stock of motors ready for immediate shipment.

Modern design . . . reliable performance . . . diversified types . . . convenient location . . . four important considerations in the selection of motors for your equipment.



WRITE FOR BULLETINS MU-177, MU-179 and MU-182



These bulletins are fully illustrated, showing cutaway views, performance curves, etc. Write for Your Free Copies Today.

M40-38

Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, Mo., U.S.A.

MOTORS • TRANSFORMERS • FANS • BRAKES

SINGLE REDUCTION
Westinghouse Type S, single reduction, explosion-proof gearmotor. (Standard ratios 1:12 to 5:1). This type available for all types of enclosures.
DOUBLE REDUCTION
Westinghouse Type D, double reduction gearmotor. (Standard ratios 5.6:1 to 10.0:1). Compact design is the result of building reduction gears and motor as one complete unit.
THERE'S A
Westinghouse
Gearmotor
FOR EVERY TYPE
OF SLOW-SPEED DRIVE
TRIPLE REDUCTION
Westinghouse Type T, triple reduction gearmotor. (Standard ratios 40:1 to 200:1). The wound rotor motor illustrated here, is adjustable in speed and starts easily under load.
SPECIAL ENCLOSURE
Westinghouse Type FD, double reduction gearmotor. (Standard ratios 10:1 to 40:1). This splash-proof enclosure and other special enclosures are available throughout the line.
WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, EAST PITTSBURGH, PA.
J-07130
Westinghouse
GEARED DRIVES

ALLIANCE
MODEL "K" MOTOR

Built for Years of Service

Powered for 1000 uses!

DEVELOPS UP TO 1/100 H. P. UNDER CONTINUOUS LOAD

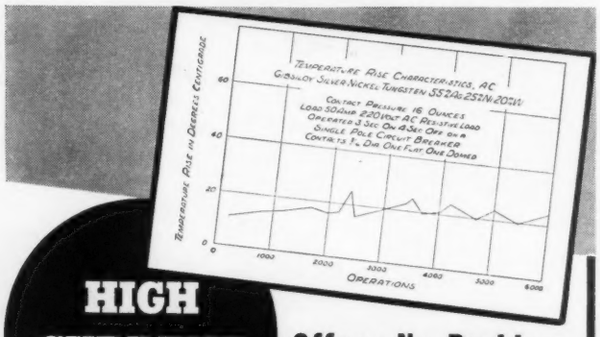
Scores of uses such as driving fans, movie projectors, and other light home appliances, powering toys, motion displays, switches and control systems—these and many other applications have proved the lasting dependability of Alliance's line of inexpensive small motors.

The recently designed, Model K shaded pole induction motor, illustrated above, is the last word in efficient small motor design. When quantity warrants, this motor can be furnished with variations to adapt the basic motor to a specific application. Model K can be produced in all standard voltages and frequencies with actual measured power outputs ranging upwards to 1/100 H.P. Greater outputs can be obtained, when used for intermittent duty only or where forced ventilation is provided. A two pole design is employed with no load rotor speeds of approximately 3450 R.P.M.

Finest materials and precision manufacturing assure long life and freedom from breakdowns.

Write today for further information. Address Dept. G.

ALLIANCE MFG. CO. • ALLIANCE, OHIO



HIGH CURRENT DENSITY Offers No Problem for Gibsiloy

SILVER-NICKEL-TUNGSTEN CONTACTS

Note in the graph above that the GIBSILOY contacts were operated under high current density for relatively long periods, and that the circuit was made and broken every seven seconds. Despite these severe conditions, the temperature rise was less than 15 deg. C., indicating low contact resistance. Other desirable properties of GIBSILOY Grade NW silver-nickel-tungsten contacts include high resistance to arcing, high conductivity, long life, and excellent non-sticking and non-welding characteristics. They have given superior performance on such applications as small circuit breakers, motor starter switches, line starters, and relays.

GIBSILOY Ductile Contacts from Powdered Metals are available in a wide variety of compositions and shapes to meet any contact requirement. Write for free copy of our new Catalog C-10.

Gibsiloy ELECTRICAL CONTACTS

Manufactured by
GIBSON ELECTRIC COMPANY
8358 Frankstown Ave., Pittsburgh (21), Pa.

NEWLY DESIGNED *for wider usage*

FENWAL THERMOSWITCH WITH JUNCTION BOX

FENWAL AIR THERMOSWITCH

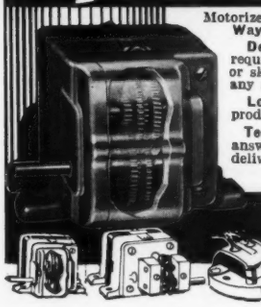
A Junction Box, now attached to the cartridge type thermoswitch as shown, allows use of BX or Conduit attached to terminal block within protective cover. Permits, also, use of graduated dial and knob and protection of lead wires. To its already wide application now is added the field of ventilation and air conditioning. "Hex" type for immersion control also available.

A compact, rugged thermo-responsive electric switch. Adjustable operation range,—50° to 400° F. Rating 10 Amp. 115 Volts, 5 Amp 230 Volts. 1/10° F. differential. Practically no thermal lag. Write for full details.

Fenwal INCORPORATED

30 MAIN STREET
ASHLAND, MASSACHUSETTS

SpeedWay Worm Drive Back Geared FLEA POWER MOTORS 110 VOLT AC, DC, or Universal



Motorize products, make them Automatic with Speed-Way Motors.

Dependable 110V Miniature Motors . . . to your requirements . . . A.C., D.C., or Universal, Case or skeleton types, with or without back gears . . . any speed or torque. Hundreds of thousands in use.

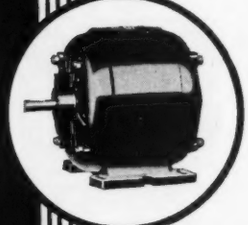
Low Cost . . . produced in volume by modern production methods. . . . surprisingly inexpensive.

Technical Service . . . state your problems, we'll answer with prices, specifications, and possible delivery dates. **Any Quantity** . . . 1 or 1,000,000.

Write for Motor Sheets

SPEEDWAY MFG. CO.
1846 So. 52nd Ave., Cicero, Ill.

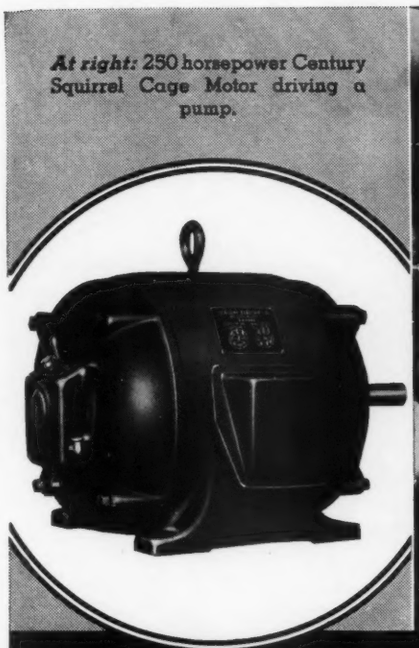
OHIO Torque MOTORS



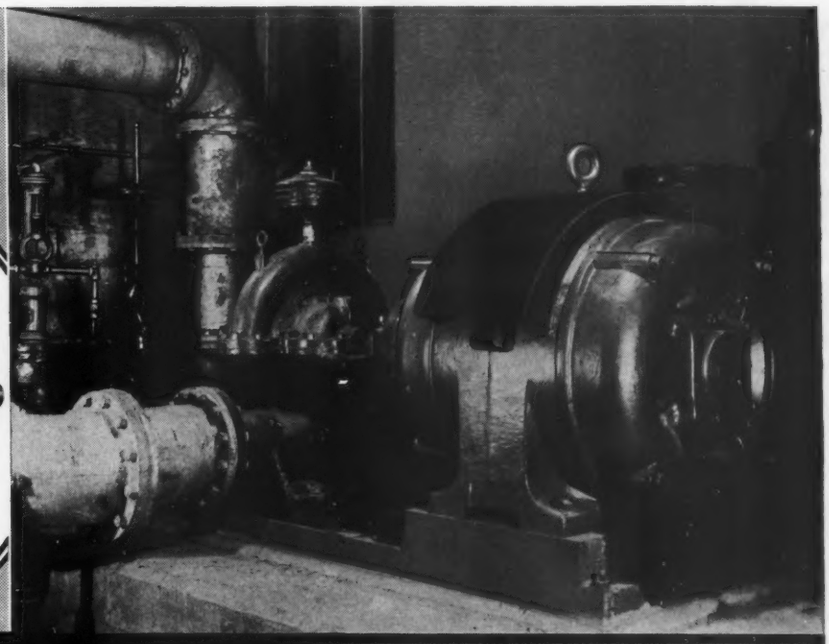
Wound to rotate slowly or stand stalled but exerting full torque, without overheating, for any length of time suitable for the cycle of operation. Ball bearing and quiet operating. Built for multiple or single phase a.c., and for direct current. Sizes to exert torque from 1 oz. ft. to 100 oz. ft. equal to 1/16 ft. lb. to 7½ ft. lb.

What is your problem?

THE OHIO ELECTRIC MFG. CO.
5911 Maurice Ave. Cleveland, Ohio



At right: 250 horsepower Century Squirrel Cage Motor driving a pump.



Century TYPE SCX MOTORS
Provide 35% Lower Starting Current

FOR

Centrifugal Pumps
Air Conditioning Fans and Blowers

It will pay you to investigate the advantages of Century Type SCX Squirrel Cage Induction Motors for applications where very low starting current is an essential requirement.

This type of Century Motor will help solve such problems as voltage fluctuations caused by the shock of heavy motor starting current—limited starter and transformer capacity—and in many applications results in a saving on expensive motor control accessories.

As an example, one Century customer using three 250 horsepower Type SCX Motors, driving large pumps, has limited his starting current to 2400 amperes per motor on a 208 volt net work line. 220 volt motors would require only 2270 amperes. Here is definite proof of the ability of Century Type SCX Motors to keep starting current low.

Century manufactures a wide variety of motor types, from fractional to 600 horsepower, all of which are equally effective in solving the numerous problems of industrial, commercial and domestic motor drives.

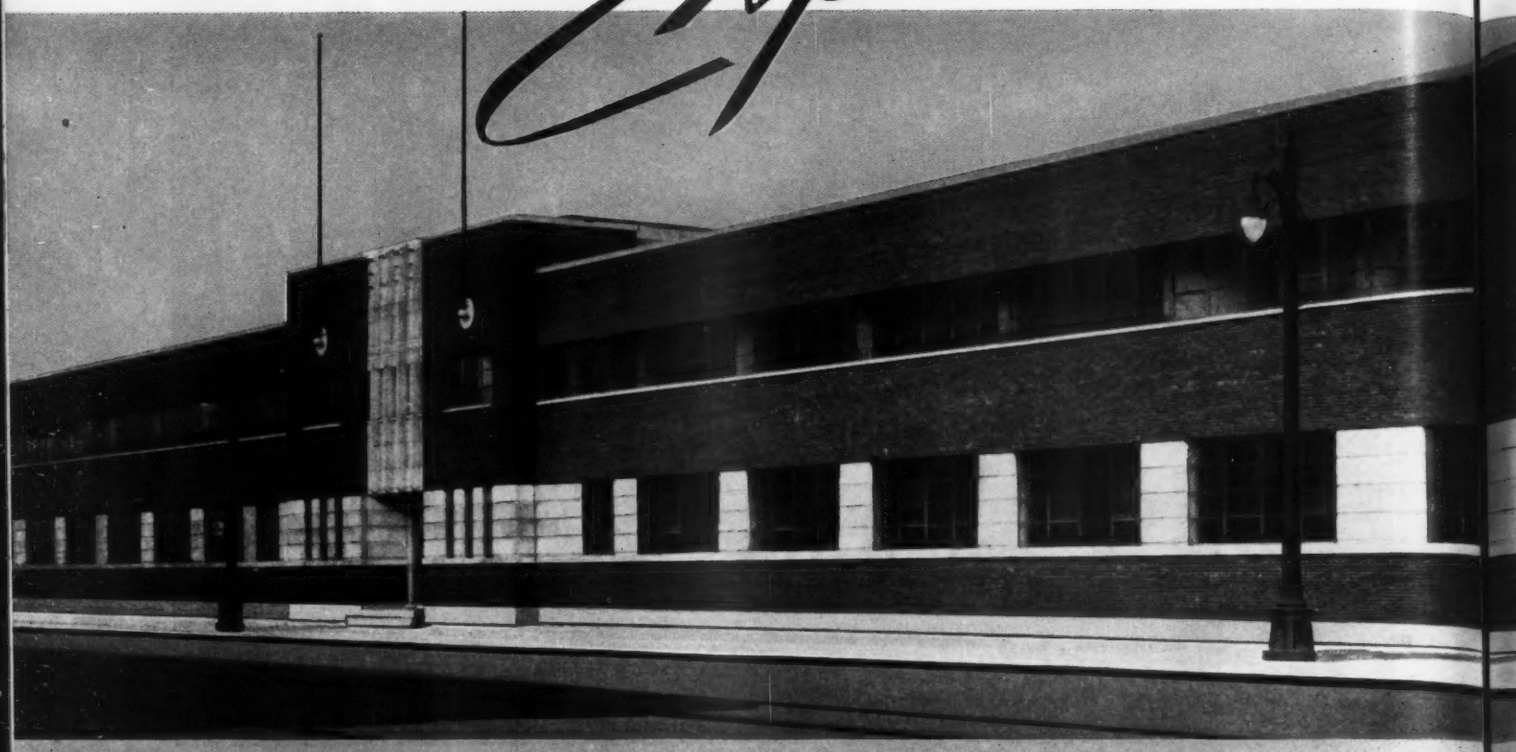
For many years, Century has specialized in the problems of refrigeration and air conditioning motorization. As a result, Century has developed specialized motors which have met the exacting requirements of thousands of installations in your industry. For complete information call in your nearest Century Motor Specialist — his advice is valuable and always at your service.

CENTURY ELECTRIC COMPANY
1806 Pine Street St. Louis, Missouri
Offices and Stock Points in Principal Cities

Century MOTORS

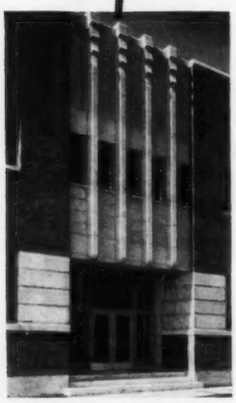
One of the Largest Exclusive Motor Manufacturers in the World

VICKERS Expands



THIS RECENTLY COMPLETED ADDITION DOUBLES VICKERS PRODUCTION CAPACITY

Depend on VICKERS for the BEST in Hydraulic Pumps and Hydromotive Controls



This splendid new addition to the Vickers plant more than doubles Vickers capacity for manufacturing and engineering research. It was built to better meet your needs—your rapidly growing demands for Vickers Hydromotive Controls.

The superior quality of Vickers Controls has been a factor in increasing the business of Vickers' customers. Their increased business has in turn increased their demands for Vickers products.

Leadership inevitably gravitates to products of definitely superior quality. Vickers aggressive research, long experience, engineering service, and improved manufacturing facilities provide assurance of continued superiority.

Engineers and builders of Vickers Hydraulic Pumps and Hydromotive Controls for machine tools, hydraulic presses, special purpose machinery, steel mill equipment, plastic and die casting machines, aircraft, etc.

VICKERS *Incorporated*

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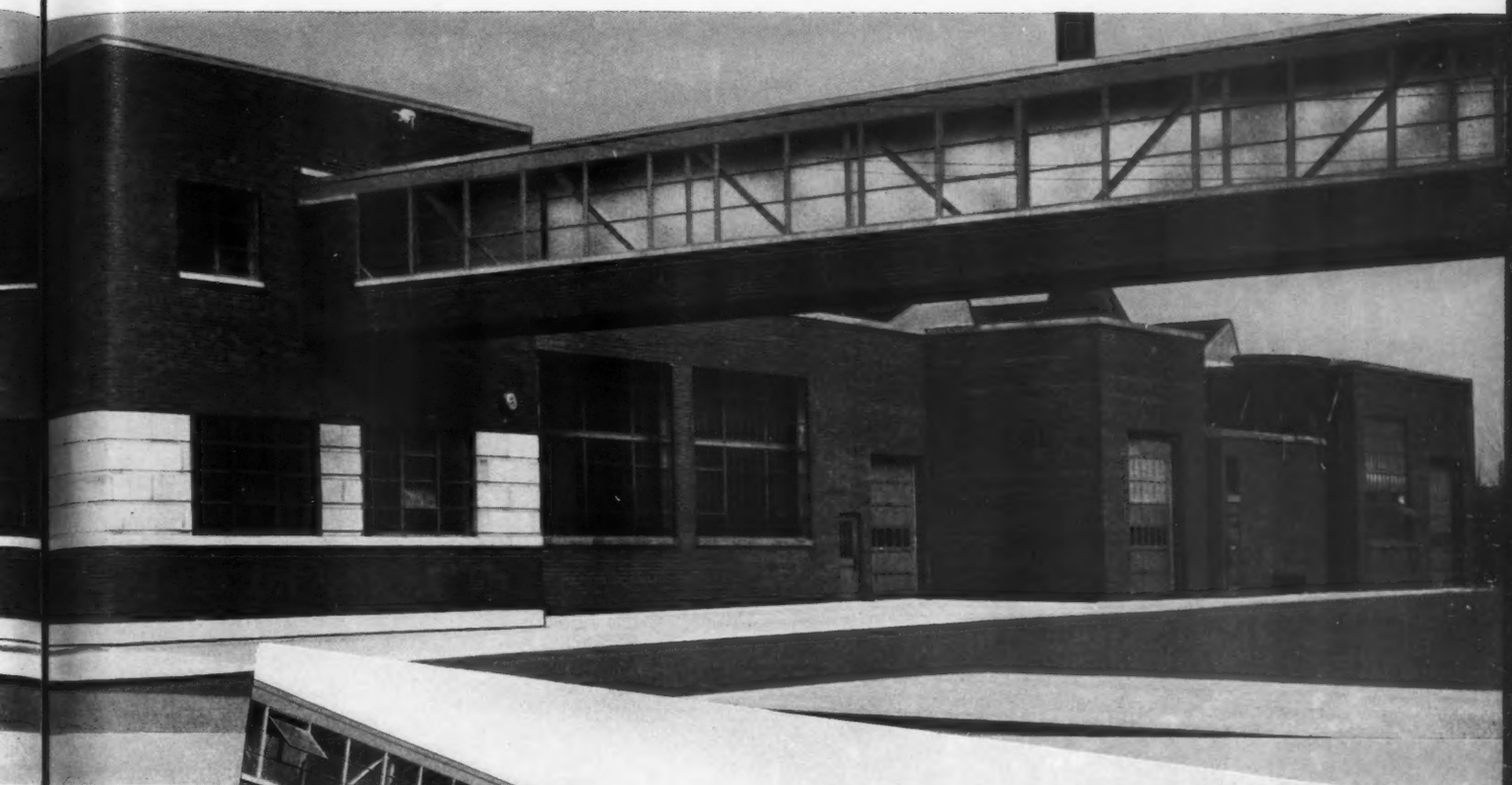
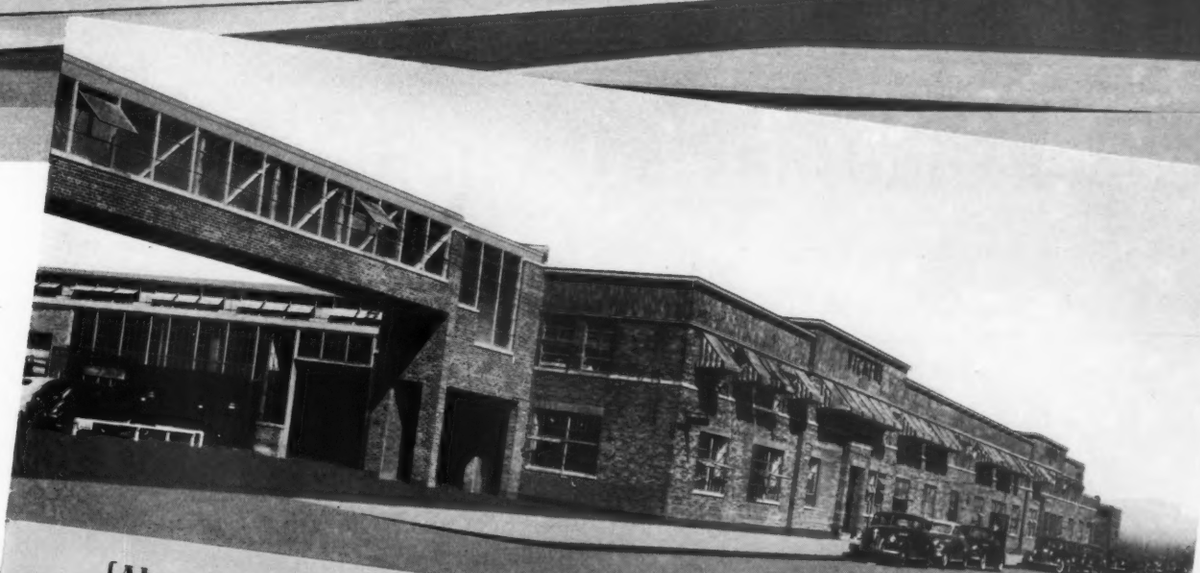
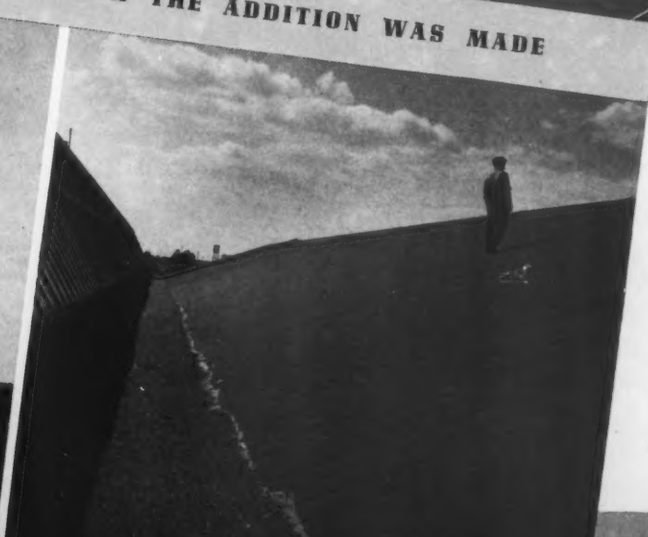
DETROIT, MICHIGAN

TO BETTER MEET YOUR NEEDS





(Above) VICKERS PLANT TO WHICH THE ADDITION WAS MADE



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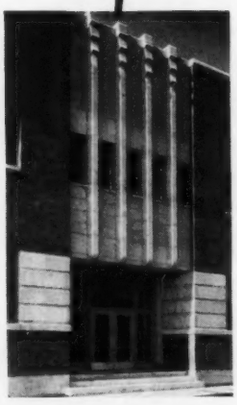
THIS RECENTLY COMPLETED ADDITION DOUBLES VICKERS PRODUCTION CAPACITY

Depend on VICKERS for the BEST in Hydraulic Pumps and Hydromotive Controls



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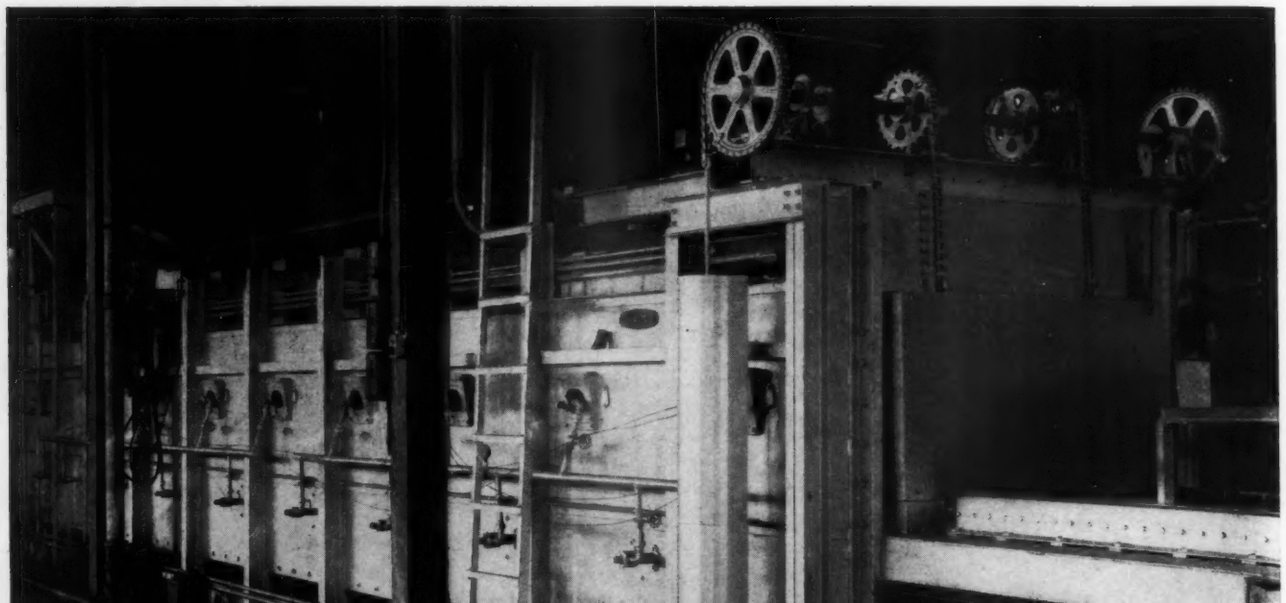

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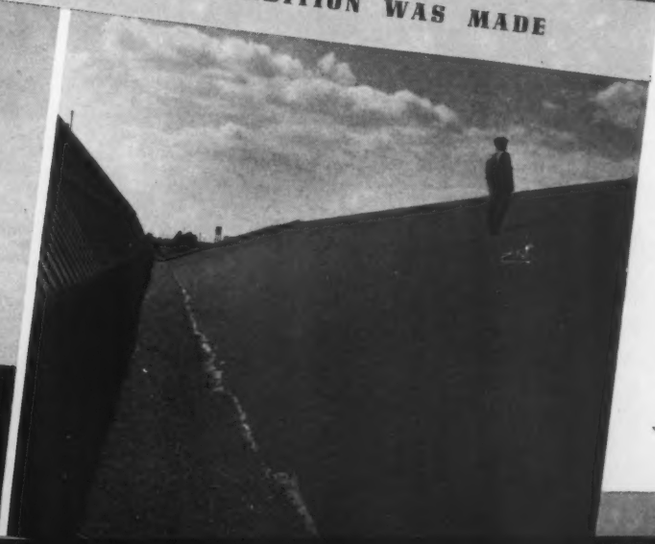

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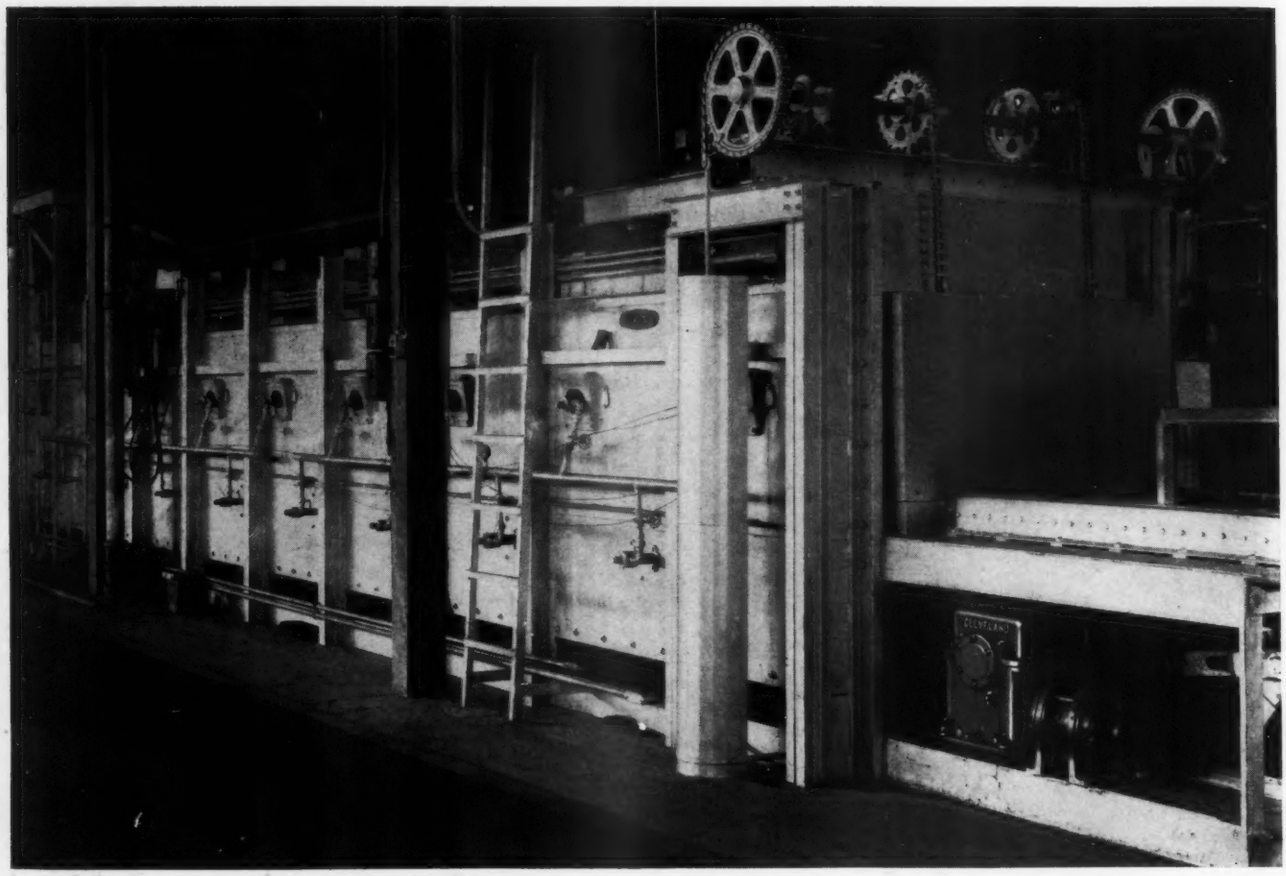
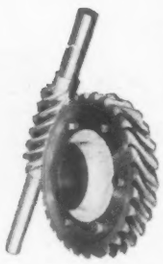


Cleveland Units on Automatic Furnaces

• Cleveland Units operate the pusher mechanism and both door hoists—all of which are synchronized to provide full automatic operation of the Holcroft Continuous Heat-Treating Furnace.



Whether *your* machines require single or multiple drive units, you can depend upon Clevelands' sturdy, hard-fighting qualities under the toughest loads—many have operated beyond record-keeping, without needing a cent's worth of replacement.

Are you *completely* up-to-date on Cleveland information? Ask an experienced District Engineer to help you select the right type, size and ratio for your own applications. The Cleveland Worm & Gear Company, 3279 East 80th Street, Cleveland, Ohio.

Affiliate: The Farval Corporation, Cleveland, Manufacturers of Centralized Systems of Lubrication
In Canada: PEACOCK BROTHERS LIMITED

CLEVELAND WORM GEAR *Speed Reducers*

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LIMITORQUE
CONTROL
operates all types of valves, etc., safely, economically, from convenient stations.
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WORM GEAR
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right angle drives—vertical or horizontal. Wide range of ratios and horsepowers.
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for heavy loads at high speed. Single, Double, Triple Reduction, various ratios and horsepowers.
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MotoReducer
The economical self-contained drive. Horizontal or Vertical types—various ratios and horsepowers.
Philadelphia GEARS
All types and sizes of industrial gears. Can be supplied in all materials.

"PLANETORQUES MUST BE SAVING A LOT OF MAINTENANCE MEN MANY HEADACHES"
"...YES, AND THEY'RE SAVING ON REPAIR COSTS FOR PLANT OWNERS, TOO"

● Now you can protect your agitators, mixers, conveyors and other equipment from damage caused by jamming or becoming overloaded. Those repair costs can be cut out, production delays eliminated and delivery dates met. How? . . . by driving this equipment with a Philadelphia PlaneTorque MotoReduceR. All Philadelphia MotoReduceRs, both horizontal and vertical, can be supplied with the PlaneTorque safety feature. It automatically and instantly shuts off the motor when the load exceeds a predetermined value. Then when load is removed, unit can be started without re-setting. Remember, PlaneTorque provides this unfailing protection to machinery and driving mechanism alike. Write us today for full details.

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Philadelphia, Pa.
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New York • Pittsburgh • Chicago

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HERE'S OHIO

"Off-the-Shelf Service"

Hurry, Hurry! Meet America's demand for more machines. Take the shortest cut to faster production on the machines you build. Save time, labor and cost. You can do it by utilizing stock gears and reducers. That's the sure way to cut one bottle neck in machine production.

For quick action on every type of stock gear or speed reducer, call the nearest Ohio Gear representative. Thousands of types and sizes are ready for immediate shipment to you. An Ohio Gear catalog will help in your selections. Send for one now.

THE OHIO GEAR CO.

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WE CAN SHIP THEM TODAY

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Adequate stocks are maintained at all times of WHS TRANSMISSION MACHINERY ITEMS in a wide range of popular sizes

PILLOW BLOCKS . . . plain and anti-friction types. Sizes . . . ¼" to 1¼" from stock.

SPROCKETS
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"V" GROOVE and CONE PULLEYS

Have you our Transmission Machinery Catalog No. 739? Sent on Request.

WINFIELD H. SMITH, Inc.

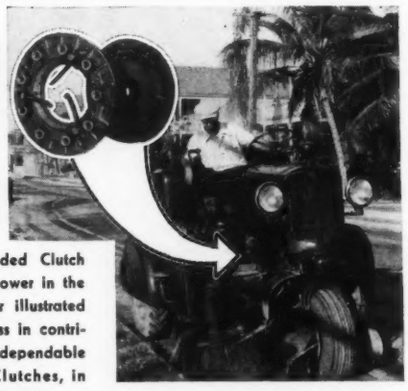
A Speed Reducer for Every Application

111 EATON STREET, SPRINGVILLE, ERIE COUNTY, N. Y.

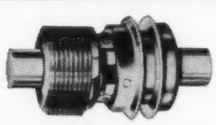
A Sweeping Success

In Austin-Western Sweepers

ROCKFORD *PLATE* CLUTCHES



A Rockford Spring-Loaded Clutch controls transmission of power in the Austin-Western Sweeper illustrated and is a sweeping success in contributing to smooth, easy, dependable operation. Rockford Clutches, in Spring-Loaded or Over-Center types, provide highly satisfactory clutch control for numerous and varied lines of equipment. The Spring-Loaded Clutch operates like an automobile clutch; the Over-Center locks in or out of engagement. Write for information. Rockford Industrial Clutches are made with single and double drive plates, for operation in oil or dry, in sizes up to 20" diameter for transmitting 2 to 80 h. p. at 100 r. p. m. Investigate.



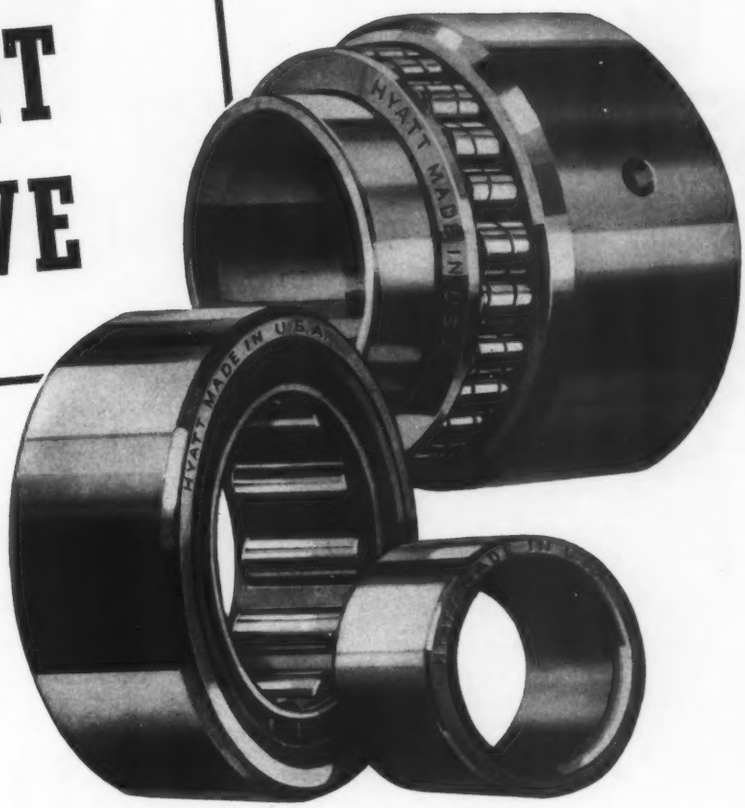
PULLMORE CLUTCHES

Multiple-disc, single and double types for oil or dry operation. Capacities from 1 to 75 h. p. at 500 r. p. m.

Rockford Drilling Machine Division *Borg-Warner Corporation*
209 Catherine Street, Rockford, Illinois, U.S.A.

Over-Center Clutches • Spring-Loaded Clutches • Pullmore Clutches

WHERE ONLY THE FIT SURVIVE



HYATT WOUND ROLLER TYPE AND HY-LOAD SOLID ROLLER BEARINGS shown opposite. Inherent design advantages, uniformity and accuracy, along with their capacity for heavy loads, account for the widespread application of these better bearings.

UNDER HEAVY LOADS day in and day out... Hyatts run smoothly and enduringly! No matter what the application—Hyatts keep equipment working... survive where others fail! Everywhere Hyatt Roller Bearings are proving their mettle and are assuring dependable operation and longer equipment life! Let us give you further facts about these better bearings for the machines you build or buy! Hyatt Bearings Division, General Motors Sales Corporation, Harrison, New Jersey; Detroit, Chicago, Pittsburgh and San Francisco.

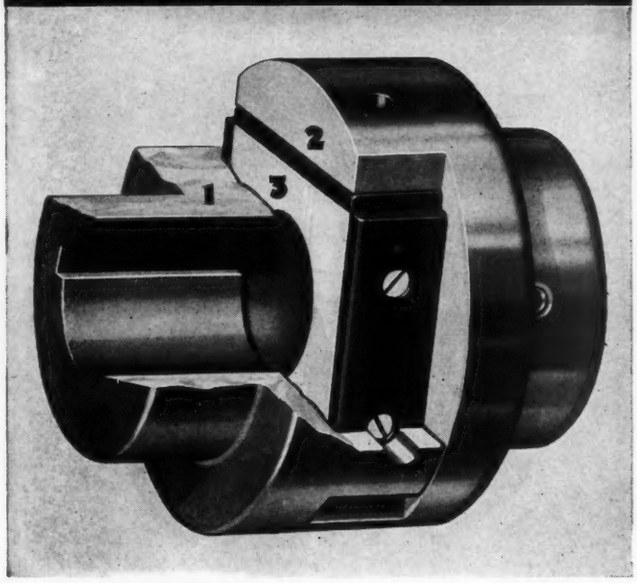
HYATT *Roller* BEARINGS

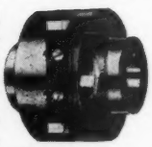
"MAKES SENSE DOESN'T IT? LESS PARTS IN A POWER UNIT HOOKUP MEANS LESS MAINTENANCE, LESS DOWN TIME, AND MORE PRODUCTION PER MACHINE".

American Flexible Couplings

HAVE ONLY 3 SIMPLE–RUGGED PARTS

2 identical jaw flanges—1 floating center block





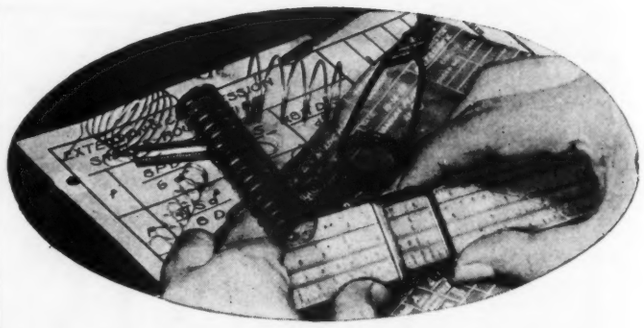
One way to make sure your equipment will deliver full machine production with a minimum of "down time" for coupling care is to use a coupling that is simple and easy to adjust.

In American Flexible Couplings, the flexibility comes from advanced mechanical design—not from flexible materials. These couplings embody an improved application of the proven Oldham Principle of Power Transmission in an economical and rugged unit. The floating metallic center block (3) is free to float in any direction between identical jaw flanges (1) and (2) compensating for misalignment without sacrificing precision of movement between machines.

American Flexible Couplings cost no more to use, and upkeep is low. Wear is absorbed by inexpensive, easily replaced non-metallic bearing strips on the load bearing surfaces of the floating metallic center block (3). For complete information write direct to the factory.

AMERICAN FLEXIBLE COUPLING CO.
(Trade Name Reg. U. S. Pat. Off.)
Erie, Pennsylvania

AMERICAN FLEXIBLE COUPLINGS *provide complete flexibility without flexible materials*



Fitting the Spring to the Need!

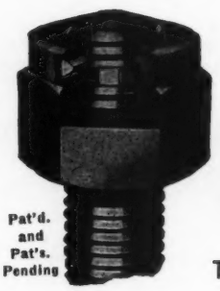
Besides prompt, accurate handling of your routine orders, Peck Service includes intelligent engineering help on your design problems when needed. If you are having trouble in a product due to a spring or screw machine part, let us help you. Meantime,

SEND FOR CATALOG

and useful technical article on spring design. Please write on your letter head.

PECK SPRINGS
AND SCREW MACHINE PARTS
The Peck Spring Co., 14 Summit St., Plainville, Conn.

UNFAILING GRIP



Pat'd. and Pat's. Pending

UNSHAKO
Reg. U.S. Pat. Off.
The Nut that can't shake loose

protects your equipment

"Unshako" nuts provide three advantages which designers find profitable:

1. The self-energizing locking ring springs to life the instant vibration creates an unwinding tendency and positively prevents it.

2. The self-energizing locking ring adjusts itself to a wide range of thread tolerances. This makes the "Unshako" an all-round locknut.

3. Neatness of appearance is another cause for enthusiasm.

Incorporate these advantages on *your* products—be sure to specify "Unshako"!

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JENKINTOWN, PENNA. Box 545
— BRANCHES —
BOSTON • DETROIT • INDIANAPOLIS • CHICAGO • ST. LOUIS • SAN FRANCISCO

For Actuation of Machine Elements

Use SUNDSTRAND *Hydraulic* Pumping Units

Here's the PWX Pumping Unit for several infinitely adjustable feed ranges, and a constant speed rapid return.

. . . For Better, Easier Designing

Automatic or Manual Control; direct or remote

Net Volume Pumping eliminates heating, saves power

Positive Self-locking Circuit prevents slack or jump

Unique advantages that provide most effective hydraulic power and flexibility make Sundstrand Pumping Units highly successful in a wide variety of applications on machine tools and other equipment. These time-tested Units are extremely simple, efficient, durable, compact. They facilitate better designing in all types of automatic or semi-automatic machinery.

Whether used for such simple movements as clutch or brake operations; or for complex automatic cycles that include work-handling . . . for fast or slow, constant or variable feeds and speeds . . . with direct or remote controls, either hydraulic or electrical . . . Sundstrand Hydraulic Equipment furnishes actuating means that are notably reliable, easy to install, economical to operate.

Sundstrand Pumping Units and Fluid Motors are built in a wide range of sizes and several standard types. Also available are Sundstrand Valves and Controls for every practical installation requirement. Investigate. Write for complete information, today.

● The Rota-Roll Pumps used in Sundstrand Hydraulic Units are patented and manufactured only by Sundstrand.

A Division of SUNDSTRAND MACHINE TOOL CO. ROCKFORD ILLINOIS U.S.A.

Sundstrand Pump Division

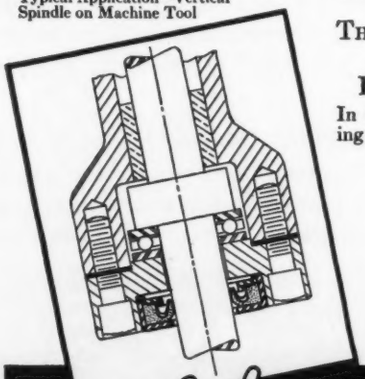
2556 Eleventh St., Rockford, Illinois, U. S. A.

THIS OIL SEAL STANDS UP

—Does not get Soft and Flabby!

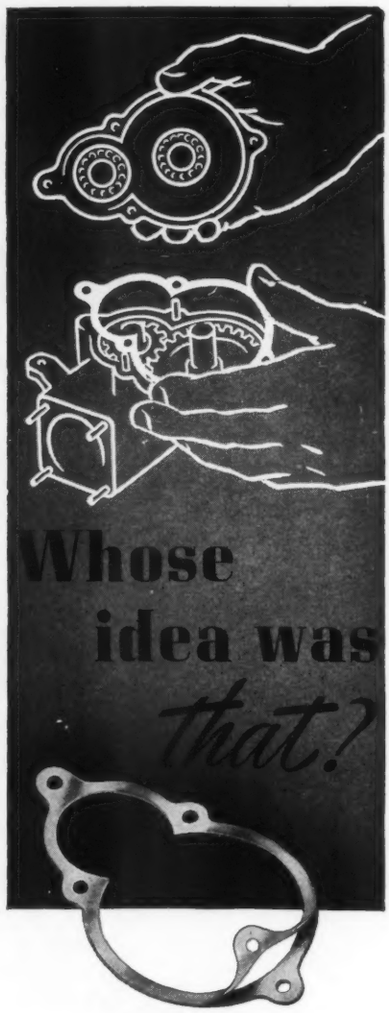
You have seen them—fighters, who seemed to have everything. But often—when the going really gets tough—you have watched them fold up, go soft. That's the way with oil seals which become soft and flabby in service. Not so with the Garlock KLOZURE Oil Seal! Made of an exclusive compound, the sealing ring of the Garlock KLOZURE *stays firm—stands up* even under the most severe conditions.

Typical Application—Vertical Spindle on Machine Tool



THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
In Canada: The Garlock Packing Company of Canada Ltd., Montreal, Que.

Garlock KLOZURE



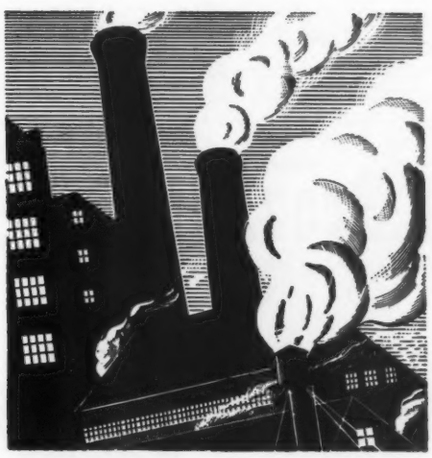
Leading aircraft builders now save many hours and dollars by *peeling* precision assembly adjustments...utilizing Laminum shims! • Throughout industry, assembly and service adjustments (for life of bearings) are made by simply peeling .002 or .003 inch laminations from "solid" brass Laminum shims. • *We supply Laminum shims cut to order. Sheet stock obtainable from mill supply houses.*

Laminated Shim Co., Inc.
63 Union St., Glenbrook, Conn.

Write for file-folder of shim application photos—with Laminum sample.

LAMINUM
THE SOLID SHIM THAT *peels* FOR ADJUSTMENT

What is America's Secret Weapon of Defense?



It isn't secret at all—this great weapon of America that forms such an essential and dependable bulwark in the scheme of national defense. Most of us come in contact with some part of it during every business day. Countless thousands of us *are* part of it. For this great "Secret" Weapon of Defense is American Industry!

The same American Industry that showed the way to the world in producing the first practical machine gun, the first submarine, the first airplane.

The same American Industry that in an earlier day established the supremacy of the rifled firearm, gave the world its first steamship, demonstrated the defensive value of armored vessels of war.

The same American Industry that is organized today as never before in its history . . . that in this era of mechanized warfare has become America's first line of defense . . . that is "secret" because no one in all the world has ever been able to gauge the full extent of its productive capacity!

SKF, with its vastly increased facilities for producing ball and roller bearings that are now being used by the Army and Navy and Air Corps, is proud to take its place alongside of the thousands of other industrial organizations that form: America's "Secret" Weapon of Defense. SKF Industries, Inc., Philadelphia, Pa.

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SKF

BALL AND ROLLER BEARINGS

the practical side of Springmaking — BY DUNBAR

What about those pesky WIRE FORMS?

* Watch your loops—Nos. 2 and 3 at left are generally less expensive than No. 1.
* Much care should be used to select proper material —round, square or rolled wire.
* In specifications, direction of action should be shown.
* Experience, not formulas, is the best qualification for wire form manufacture.

"Nothing on our mind but Springs"

HERE'S WHAT TO DO:

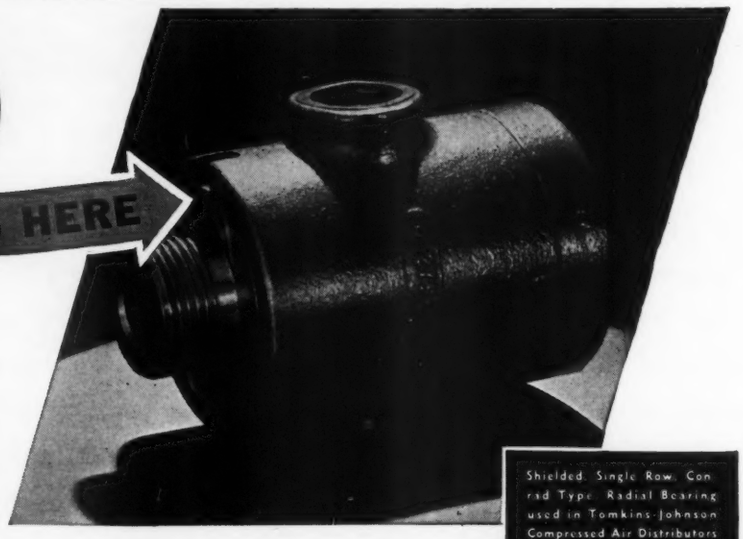
If you want real common-sense advice on this very individual and specialized subject, send your part here, together with information about its use. We'll look it over for improvement or suggestions.

Dunbar Bros. Co., Bristol, Conn.

DIVISION OF ASSOCIATED SPRING CORPORATION

"Quality Springs Since 1845"

BCA BALL BEARINGS HERE

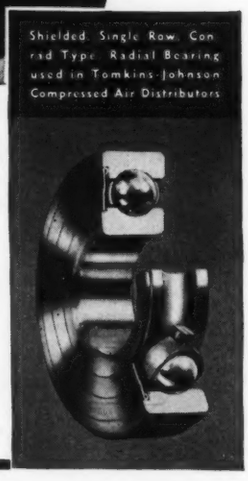


Insure Positive Clutch Action

POSITIVE ACTION—that's what heavy machinery manufacturers expect from the Tomkins-Johnson Compressed Air Distributor for air operated clutch cylinders, illustrated. Its failure on a giant hydraulic press might ruin costly dies—upset production schedules—and result in losses running into thousands of dollars.

Tomkins-Johnson engineers realize this —do everything possible to make their Compressed Air Distributors fool proof. Careful design and the high-grade basic materials of BCA Ball Bearings all play their part.

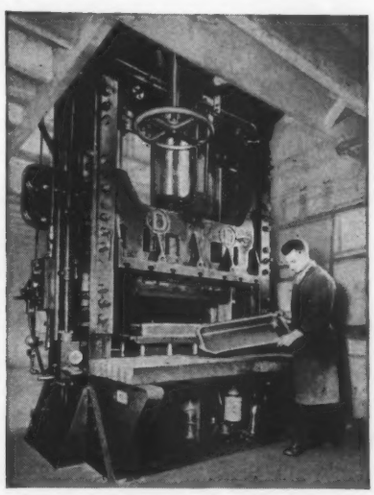
The Tomkins-Johnson Company follows the lead of important manufacturers in many lines when they rely on BCA Ball Bearings. The next time *you* need ball bearings talk to a BCA sales-engineer. BEARINGS COMPANY OF AMERICA, LANCASTER, PENNA.



BCA RADIAL • THRUST • ANGULAR CONTACT BALL BEARINGS

Control MOVING MASSES *easily*

AN ADVANTAGE OF A-E-CO HELE-SHAW FLUID POWER



Triple-action hydraulic press manufactured by Dominion Engineering Company. Three down-stroking rams may be used together or alternately to secure a variety of pressures. Pressures further adjustable by Hele-Shaw pump control.

WHEN you think of hydraulic operation do you get a picture of a slow moving platen on a ponderous press? Hele-Shaw Fluid Power *will* do that job because it's a brute for pressure. But forget it for a moment.

Take a look at a heavy, Fluid Power operated table on a face grinding machine doing a smooth 60 or better strokes per minute, or the big ram of a bull-dozer, or an airplane catapult and you'll see how easily heavy moving masses can be controlled with Fluid Power.

But there's more to Fluid Power (oil under pressure for driving machines) —mechanical simplicity, dependability, freedom from lubrication. There's infinitely variable control of speeds with fine, accurate control.

You can set-up machines for manual or completely automatic control over a multiplicity of simultaneous or sequential steps.

You can put the Hele-Shaw pump any convenient place on or off the machine... operate it by remote control.

Yes, you'll find Hele-Shaw Fluid Power has many other benefits. Tell us your problem and we'll gladly dig out a solution from our files or experience.

A-E-CO HELE-SHAW *Fluid* POWER

AMERICAN ENGINEERING COMPANY

4501 ARAMINGO AVENUE, PHILADELPHIA, PA.

Other A-E-CO Products: Lo-Hed Hoists, Taylor Stokers, Marine Deck Auxiliaries.

Here it is—
COMPLETE with
motor AND Pump!

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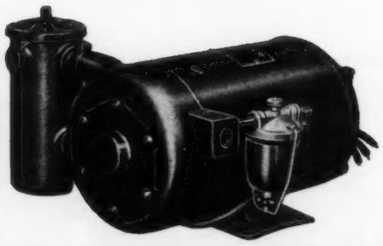
Cleaner AIR
AND longer WEAR!

MOTOAIR

VACUUM or PRESSURE PUMPS



Note the SPACE-SAVING—
and absence of "wearable" parts!

Machine Designers find MOTO-AIR a definite contribution toward compact construction on machines which require vacuum, pressure or both! Can be installed for standard, wall or ceiling mounting . . . Supplied in wide range of pressure or vacuum—and gives more volume for any given input!

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"stripped" PUMPS

Save space and money by building lubricating or coolant pumps directly into the design of your machine. Tuthill introduced "Stripped" pumps for this purpose—now supplies thousands to the field. Capacities up to 50 g. p. m. in types to meet all requirements. WRITE FOR COMPLETE INFORMATION TODAY

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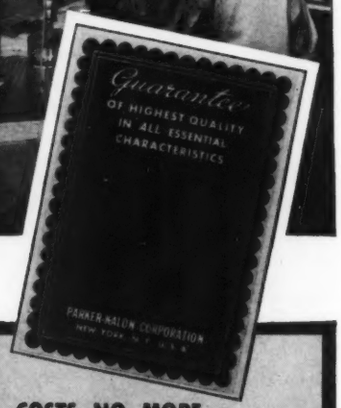
eliminate the "Doubtful Few"

Some of the scientific check-ups in the 16-Point Quality-Control routine.



. . . when Parker-Kalon's Quality-Control Laboratory backs your fastening devices

You get an unequalled protection against time-wasting, cost-boosting "duds" among your fastening devices when you specify Parker-Kalon! For, in Parker-Kalon's plant, an unusual Quality-Control Laboratory stands guard over all production, to eliminate the "doubtful few" screws that slow-up assembly work and produce unsatisfactory fastenings.

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Take no chances in your assembly jobs . . . buy Hardened Self-tapping Screws, Socket Screws or other fastening devices that are made in the screw industry's most modern plant. Parker-Kalon Corporation, 196 Varick Street, New York.

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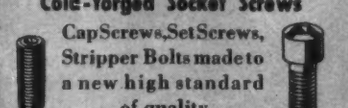

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Cold-forged . . Neater, Stronger

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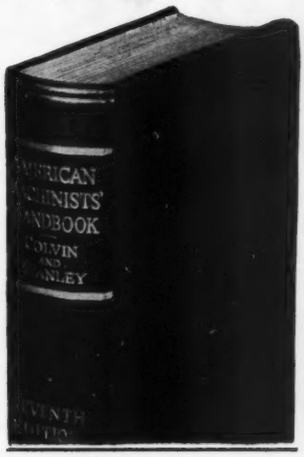

At no additional cost to you, we will stamp your name, or a friend's name, in gold on the front cover of any copy of Colvin and Stanley's American Machinists' Handbook, 7th edition, ordered from this advertisement. This is a special Christmas offer, limited to acceptance before January 1, 1941.

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28
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O.Z. COUNTS ON P-K FOR THE "SQUEEZE"

AVOIDS "DOUBTFUL" SCREWS BY USING QUALITY-CONTROLLED PARKER-KALON SOCKET SCREWS

Great pressure is required in making this electrical connection permanently secure. It is no job for "doubtful" socket head cap screws. That's why O. Z. Electrical Mfg. Co., Inc. specifies PARKER-KALON and says: "The exceptionally high tensile strength more than meets our unusual requirements . . . tremendous pressure does not damage the socket . . . unvarying uniformity of dimension satisfies our own close tolerances."

Every manufacturer who seeks maximum protection against the troubles which may be caused by a few "doubtful" – imperfect – screws in a lot, is sure to be interested in the unique Quality-Control routine under which Parker-Kalon Socket Screws are produced.

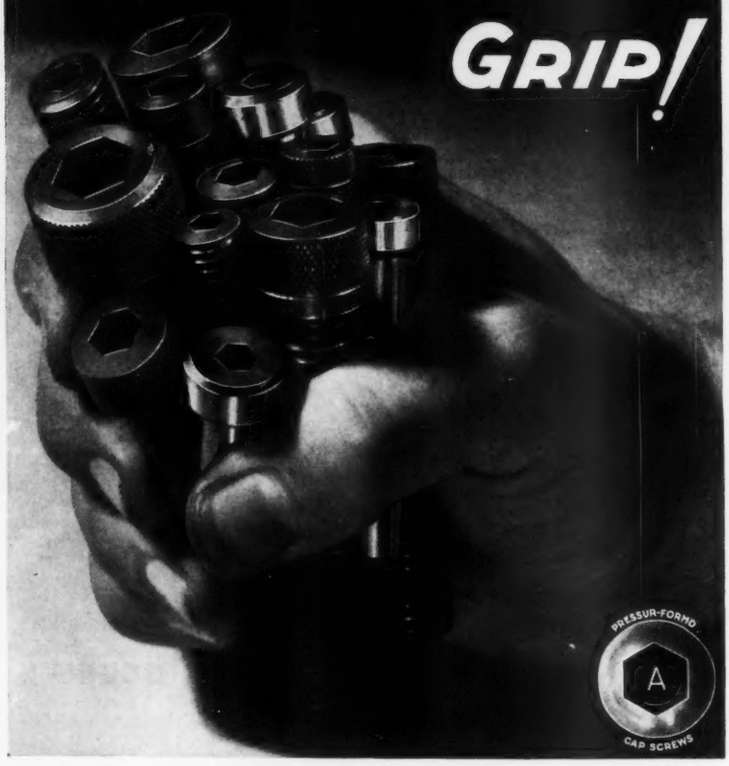
WRITE FOR FOLDER AND SAMPLES – read about this routine and the amazing Parker-Kalon Laboratory which makes it possible to maintain a new high standard of quality in socket screws. Free samples and local distributor's name will also be furnished. Parker-Kalon Corporation, 196 Varick Street, New York, N. Y.

Quality-Controlled

16-point test and inspection routine covers: Chemical Analysis; Tensile and Torsional Strength; Ductility; Shock Resistance under Tension and Shear; Hardness; Head diameter, height and concentricity; Socket shape, size, depth and centricality; Class 3 Fit Threads; Clean-starting Threads.

PARKER-KALON
COLD-FORGED
Socket Screws

ALLEN HOLLOW SCREWS



MANAGEMENT'S grip tightens on the tools of production; engineers bear harder on speeds and stresses; machines are racked by the reckless strains of emergency operations.

But *ALLENS* HOLD. They are "steeled" to hold, threaded to hold, hardened to hold. The technical history of their development is three decades of TESTS — *duplicating emergency conditions.*

There may have been times when *ALLENS* were better screws than you needed. But not in times when the nation's strength waits on *uninterrupted production!*

Above all the technical reasons why *ALLENS* won't fail, we refer you to the 30-year record and ask your confidence in a REPUTATION as the one reason for *specifying* the name.

Call your local Allen Distributor for accommodating service.

THE ALLEN MANUFACTURING COMPANY
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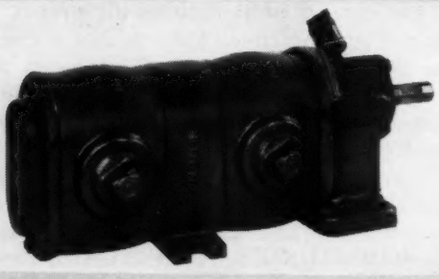

Fitted to *your* particular requirements

— **Stock Pumps** in a wide variety of types and sizes — Geared — Vane — Centrifugal.

— **Special Pumps** made to your order (often many standard parts can be used, as in the dual type shown above).

B·S **Write for Pump Catalog**

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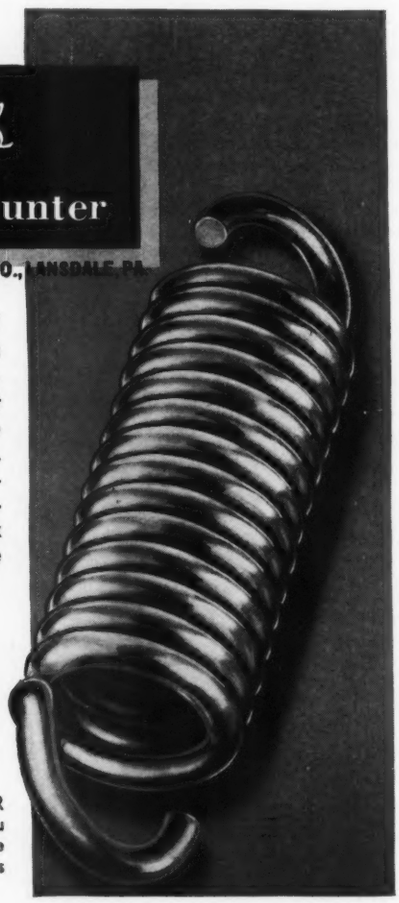
HUNTER PRESSED STEEL CO., LANSDALE, PA.

All types . . . all sizes . . . all materials . . . Made to accurate standards so that *each* spring has the needed properties. Our engineering department has a reputation for good work —is at your service at any time.

HUNTER SPRINGS - STAMPINGS

The hundreds of HUNTER customers will tell you the best way to get the *right spring* for the job is the HUNTER Way!



The PAY-OFF is the PULLING POWER of Dayton V-BELTS *with Daytex Cord*

Since conversation won't cut production costs, you may be bored stiff when we tell you how Dayton's famed technical laboratories spent seven years of tireless research developing Dayton V-Belts with Daytex Cord in their neutral axis section.

You may even stifle a yawn as you hear about the exhaustive laboratory tests which *prove beyond question* that Daytex Cord has less stretch, longer life and greater strength than the best comparable cord *not* Daytex Processed.

But unless you are allergic to profits you will sit up straight and listen to this brass tack fact—the pay-off is the pulling power of these new Dayton Cog-Belts with Daytex Cord, and *that* means a boost for your bank roll.

So remember this, field applications under all conditions in all types of industries, in all climates and places prove that Dayton V-Belts with Daytex Cord *take and like* constant high speed flexing to give you greater power and lower cost per day, per month or year.

Remember that Dayton V-Belts are outstanding in basic design because they are built to bend with patented cog construction. They reduce adjustments to a negligible minimum. They work on short centers and save space. They save you time, they save your machinery and they save you money. So why not ask your local Dayton distributor for catalogs, data and "The Picture Story of Daytex Cord?"

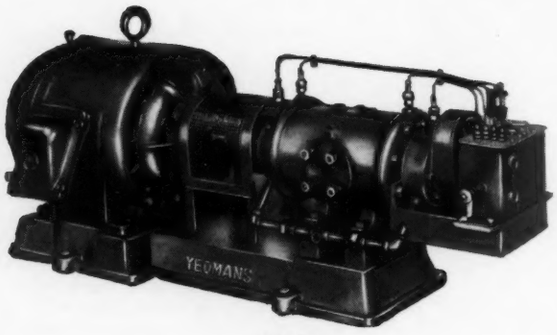
THE DAYTON RUBBER MFG. CO.
DAYTON, OHIO

Dayton
V-BELT DRIVES
WITH DAYTEX CORD

THE ONLY BELT WITH PATENTED BUILT-TO-BEND CONSTRUCTION

MADE BY THE WORLD'S LARGEST MAKERS OF V-BELTS

FRANKLY, WE'RE EXPLORING



AND

If You Use Air or Gas Compressors or Dry Vacuum Pumps, This Will Fascinate You

Yeomans' rotary compressor is moving in on other types up to 500 C.F.M., pressures to 50 lbs.; dry vacuum pumps to 27 in. Its advantages are so many, its application is so wide, that its use is a matter of election on the part of engineers in chemicals, foods and power and as integral units on production equipment.

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Small space requirement . . . no belts, pulleys, valves or stuffing boxes . . . non-pulsating air flow . . . no air storage tank . . . high efficiency . . . little need of attention . . . and low cost . . . do these appeal to you? In the interest of your own effectiveness and your plant's efficiency—write!

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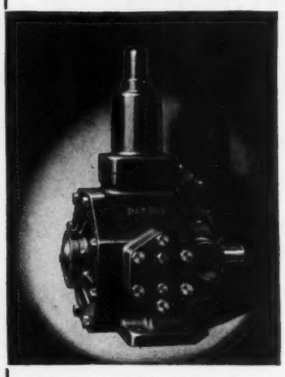
You Too May Have HYDRAULIC POWER AT LOW COST



New RACINE Variable Volume Hydraulic Pump.

FOR Forcing, Straightening, and Bending • Die Casting • Plastic Molding • Machine Tool Applications • Lifts and Elevators • Mining Machinery • Stokers • Excavating and Materials Handling • Welding • Embossing and Die Sinking • And many other special applications.

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In Capacities • 12-20-30 gal. per min. Of Variable Pressures —up to 1000 lbs. per sq. in.

RACINE Variable Volume Hydraulic Pumps automatically maintain any desired pressure up to 1000 lbs. per sq. in. without by passing of oil. Their use means less Horse Power Consumption—Minimum of Oil Heating—Least Noise.

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RACINE

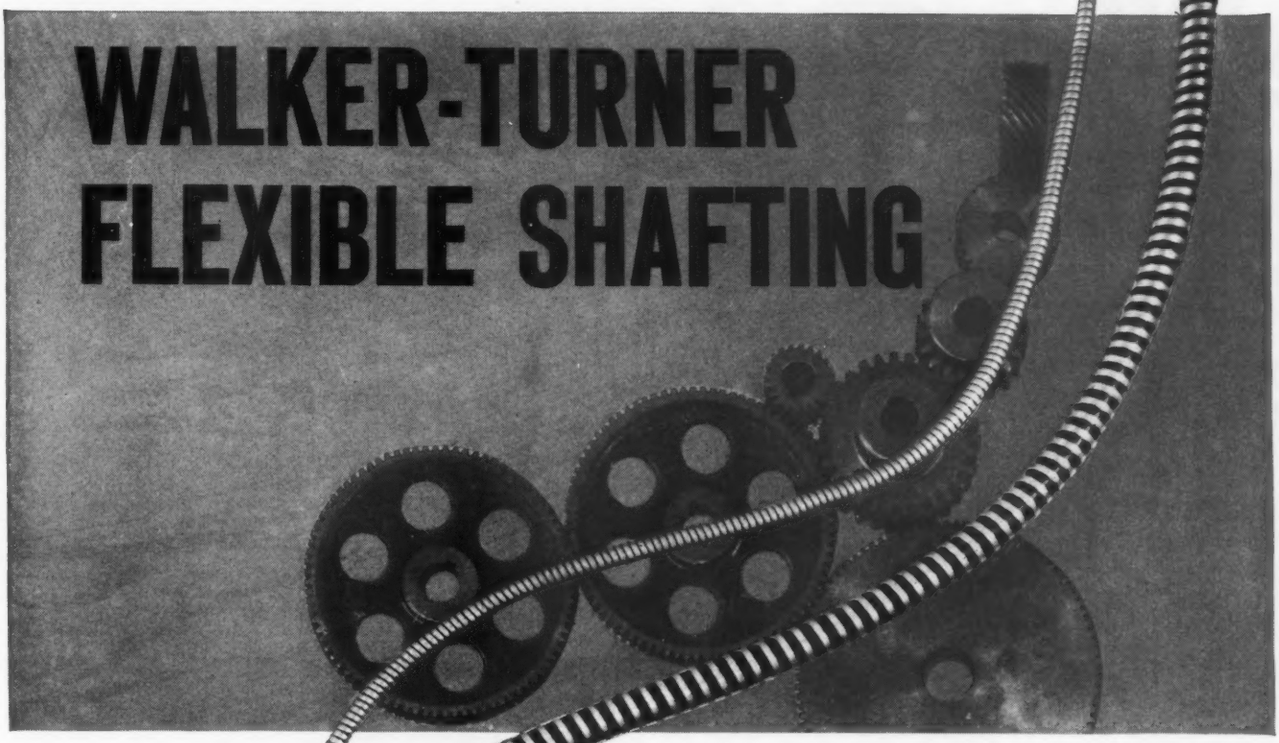
Delicate responsiveness to the slightest pressure... or carrying capacities of thousands of pounds... it's all in the day's work for B-G-R Springmakers. A Scientific Knowledge of materials, manufacture and heat-treating gives good results. Economy and satisfactory performance follow as a matter of course.

SPRINGS
SMALL STAMPINGS
WIRE FORMS

Let B-G-R analyze your next spring action

BARNES-GIBSON-RAYMOND
DETROIT PLANT — DETROIT, MICHIGAN ← TWO PLANTS → COOK PLANT — ANN ARBOR, MICHIGAN

BEFORE YOU "INK IT IN" —BETTER LOOK INTO



Many prominent manufacturers of mechanical equipment have adopted flexible shafting for power transmission and remote control to simplify design, reduce manufacturing cost and improve product acceptance. These include instruments, power tools, aircraft, production machinery, automobiles, appliances, accessories, and numerous other items.

In the change-over from more complicated and less satisfactory forms, the engineering staff of the Flexible Shafting Department of Walker-Turner Company, Inc. has rendered much helpful service. This Company is particularly well qualified to assist in such matters because of the wide range of experience we have acquired as one of the largest manufacturers of flexible shaft machines for industry. We are glad to place this knowledge at the disposal of all manufacturers interested in considering the possibility of applying flexible shafting to their own products.

For detailed recommendations, write Walker-Turner Company, Inc., 44120 Berckman Street, Plainfield, New Jersey,

OTHER WALKER-TURNER PRODUCTS

FLEXIBLE SHAFT MACHINES • BENCH GRINDERS • DRILL PRESSES • METAL-CUTTING BAND SAWS MOTORS • RADIAL CUT-OFF MACHINES AND OTHER MACHINES FOR WORKING METAL, WOOD AND PLASTICS

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WALKER-TURNER MACHINE TOOLS

FOR METAL, WOOD AND PLASTICS

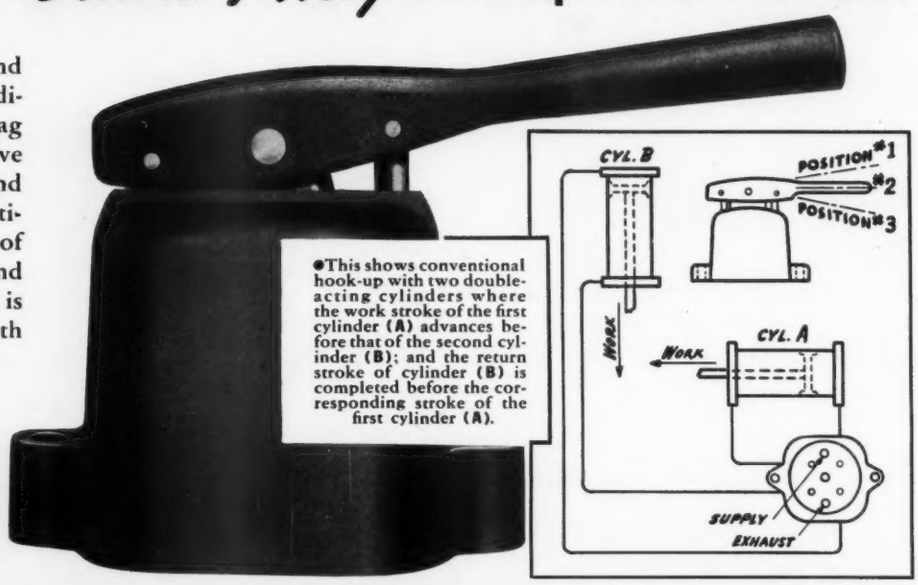
NEW QUICK-AS-WINK

Double 4-Way Hand Operated Air Valve

This Q. A. W. valve simplifies and facilitates control where two individual air cylinders lead and lag each other. It assures more positive and accurate control, saves air, and effects economies in piping. Particularly adapted for operation of air-operated clamps, fixtures, and similar applications wherever it is more convenient to operate with one point of control.

Send for catalog describing this and other Q. A. W. air and hydraulic control valves.

C. B. HUNT & SON
1850 E. PERSHING ST., SALEM, OHIO



●This shows conventional hook-up with two double-acting cylinders where the work stroke of the first cylinder (A) advances before that of the second cylinder (B); and the return stroke of cylinder (B) is completed before the corresponding stroke of the first cylinder (A).

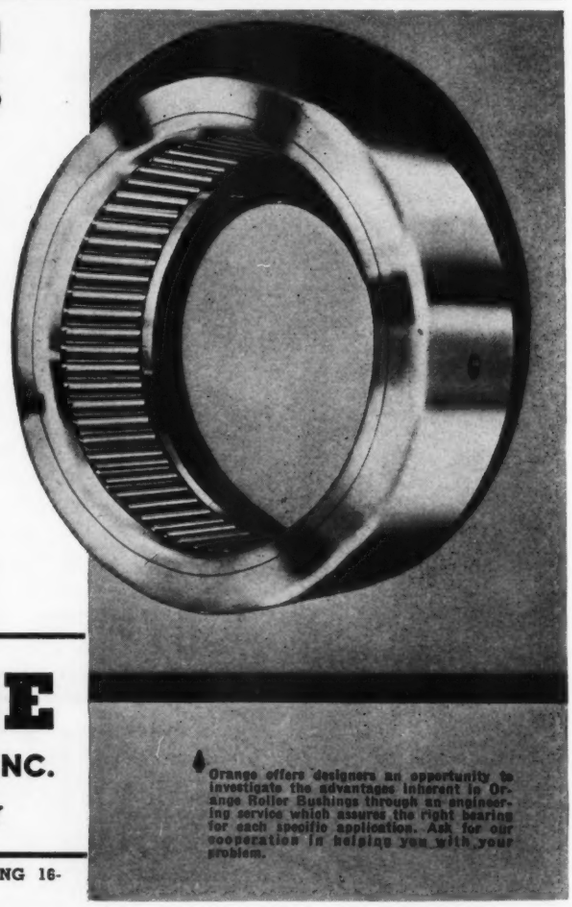
DESIGNING ENGINEERS IN EVER-INCREASING NUMBERS ARE APPROVING ORANGE ROLLER BUSHINGS

Full details of the design and application of Orange Roller Bushings are contained in our Bulletin "RB" sent FREE on request. Send for this valuable 16-page engineering data book.

Product improvement and Orange Roller Bearings go hand in hand as designing engineers study the advanced design and outstanding features offered by these new bushings. Trial applications quickly lead to acceptance.

Ease of application, extreme accuracy of all parts and true running appeal to engineers. Precision achieved by the methods employed in grinding and by a unique means of assembly is another reason why more and more designing engineers investigate the possibilities of Orange Roller Bushings—and then standardize on them.

"Orange" engineering service is available to help you, too, in achieving product improvement through simplified design and better bearing service and efficiency.



Orange offers designers an opportunity to investigate the advantages inherent in Orange Roller Bushings through an engineering service which assures the right bearing for each specific application. Ask for our cooperation in helping you with your problem.

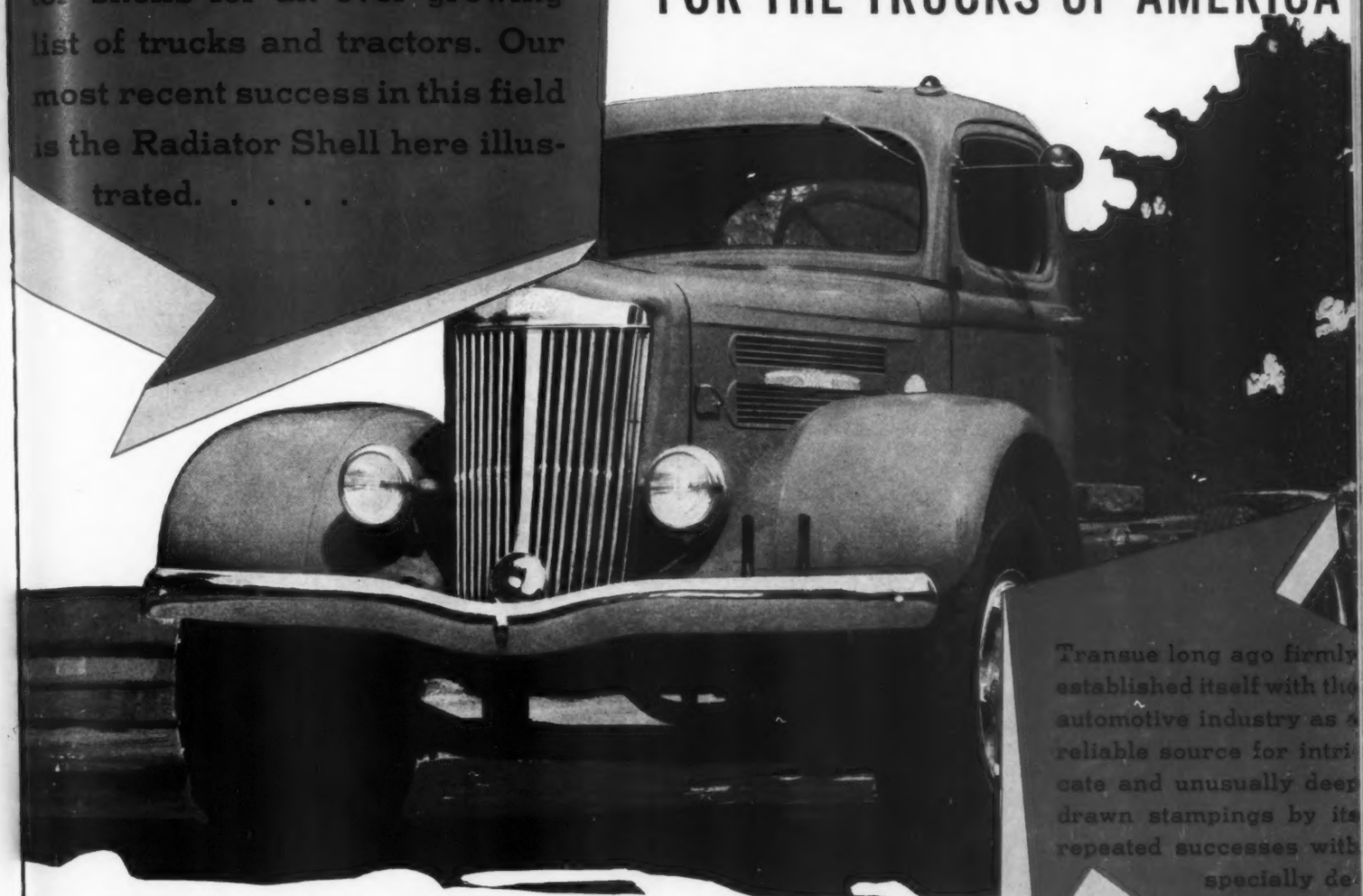
ORANGE
ROLLER BEARING CO., INC.
ORANGE, NEW JERSEY

YOUR FREE COPY OF THE ORANGE ROLLER BUSHING 16-Page Data Book is READY. ASK FOR IT!

PRESSED STEEL STAMPINGS

FOR THE TRUCKS OF AMERICA

Transue has, in the past two years, been chosen to design and produce pressed steel radiator shells for an ever growing list of trucks and tractors. Our most recent success in this field is the Radiator Shell here illustrated. . . . .



Transue long ago firmly established itself with the automotive industry as a reliable source for intricate and unusually deep drawn stampings by its repeated successes with specially designed truck oil pans.

● The automotive industry is only one of many industries now looking to Transue for design help in producing parts or products in pressed steel. The reason is twofold: our ability to design unusual stampings to fit unusual requirements—and our facilities, after that, to produce them economically.

The Transue engineering department welcomes new problems in pressed steel . . . so write, wire or phone any of our district offices for a man to talk it over—no obligation.

FOR THOSE MANUFACTURERS HAVING THEIR OWN PRESS EQUIPMENT, TRANSUE WILL GLADLY QUOTE ON DIE REQUIREMENTS.

TRANSUE & WILLIAMS

ALLIANCE · OHIO

DESIGNERS AND MAKERS OF DEEP DRAWN STAMPINGS

SALES OFFICES

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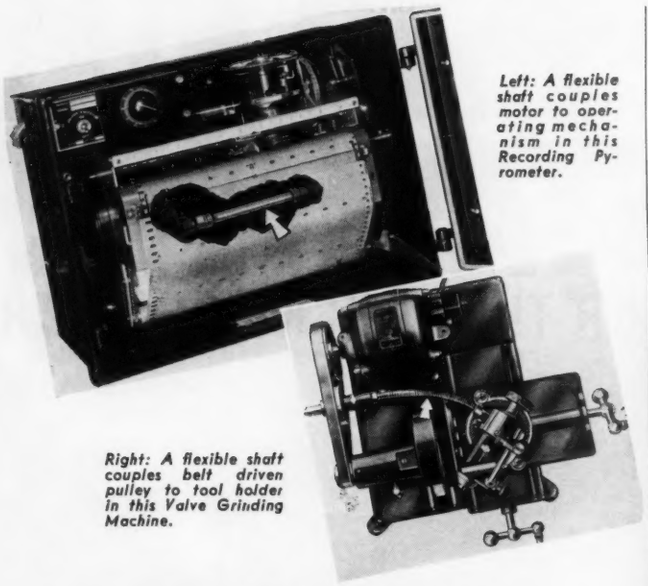


Left: A flexible shaft couples motor to operating mechanism in this Recording Pyrometer.

Right: A flexible shaft couples belt driven pulley to tool holder in this Valve Grinding Machine.

"COUPLING" with S. S. WHITE FLEXIBLE SHAFTS OFFERS MANY ADVANTAGES

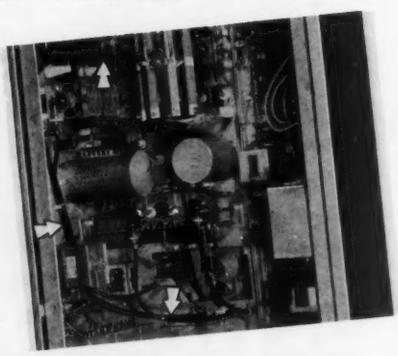
The typical examples illustrated suggest the possibilities of this fast growing use of S. S. WHITE Flexible Shafts. Here are the advantages of "coupling" with flexible shafts.

SIMPLICITY — Regardless of the relative locations of the parts "coupling" is accomplished with a single, easily applied element.

IMPROVED DESIGN — "Coupling" makes it possible to locate parts requiring connection in whatever positions best satisfy electrical circuit, easy assembly, space saving and convenient servicing.

ECONOMY — "Coupling" makes accurate alignment of parts unnecessary, thus simplifying assembly and reducing labor costs.

Information about "Coupling" is contained in Flexible Shaft Bulletins 1238 and 38. Write for them.



"Coupling" shafts made possible the location of tuning units in best circuit positions with controls centralized in this Broadcast Transmitter.

S. S. WHITE

The S. S. White Dental Mfg. Co.

INDUSTRIAL DIVISION

Department D, 10 East 40th St., New York, N. Y.

FLEXIBLE SHAFTS for POWER DRIVES, REMOTE CONTROL and COUPLING

RESILIENT NON-METALLIC LOCKING COLLAR automatically eliminates thread play and holds load-carrying thread faces in constant pressure-contact • ***Write for Catalog.***

ELASTIC STOP NUT CORPORATION

2328 VAUXHALL ROAD • UNION, NEW JERSEY

Elastic Stop SELF-LOCKING NUTS

. . . in fuel pumps • in pressure regulators and indicators • in flying instruments • and even in some of the meteorological instruments that help direct its safe flight to a "happy landing."

Where failure is unthinkable . . . equipment manufacturers naturally turn to the simplicity, ruggedness and all-'round dependability of Sylphon Bellows.

Add to the life and serviceability of your products — with the durability of all-metal construction replacing less dependable materials. Consult with Sylphon engineers. Ask for Bulletin XP-511.

Sylphon SEAMLESS METAL BELLOWS

The Fulton Sylphon Co.

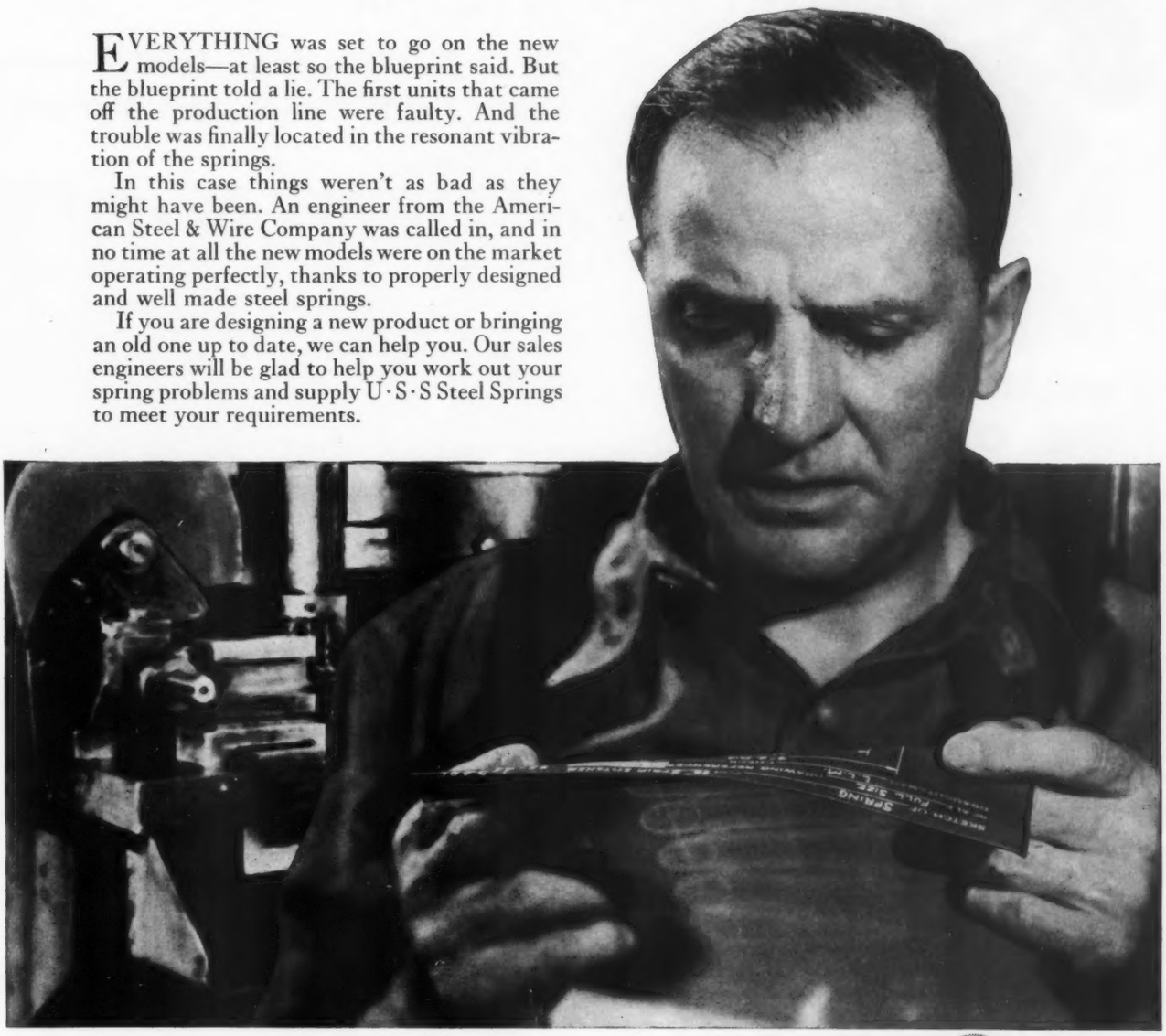
KNOXVILLE, TENNESSEE

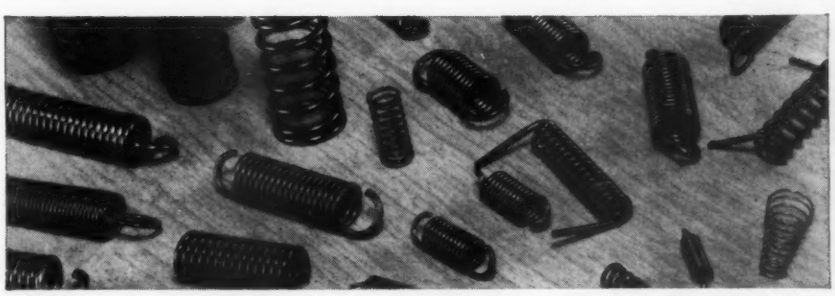
The Blueprint that told a Lie

EVERYTHING was set to go on the new models—at least so the blueprint said. But the blueprint told a lie. The first units that came off the production line were faulty. And the trouble was finally located in the resonant vibration of the springs.

In this case things weren't as bad as they might have been. An engineer from the American Steel & Wire Company was called in, and in no time at all the new models were on the market operating perfectly, thanks to properly designed and well made steel springs.

If you are designing a new product or bringing an old one up to date, we can help you. Our sales engineers will be glad to help you work out your spring problems and supply U·S·S Steel Springs to meet your requirements.





USS

AMERICAN *Quality* SPRINGS

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

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UNITED STATES STEEL

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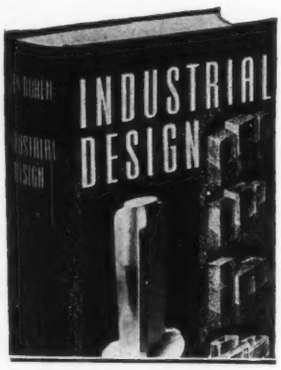

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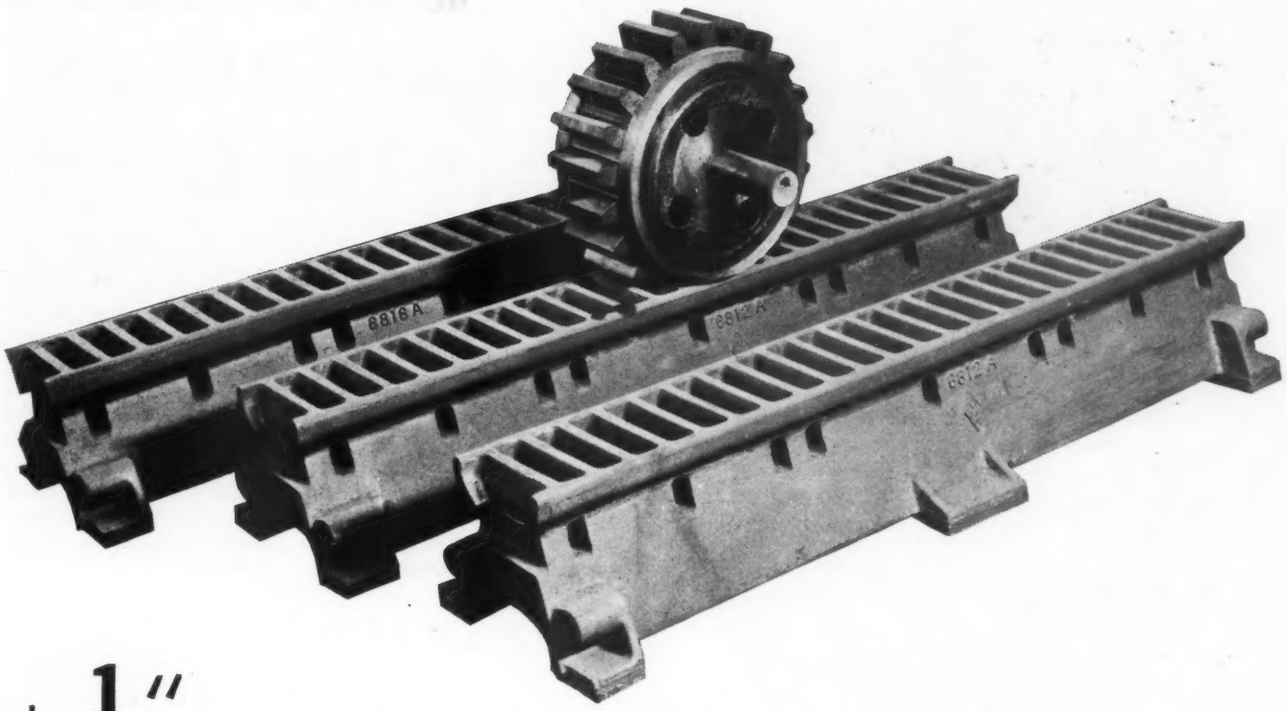

$\pm \frac{1}{16}$" pitch tolerance between end teeth ...AS CAST IN QUANTITY PRODUCTION!

Yes, that's right! The order called for 189 racks like those illustrated—ranging from 2' 1" to 6' 3" long—with a maximum allowable variation in pitch between end teeth of $\pm$ 1/16" just as cast *without machining*.

And look at these additional specifications for precision! That machine cut pinion you see on the middle rack is a test pinion. Each rack had to be further inspected by rolling this pinion along the rack. The *machined* shrouds of the pinion had to be in perfect rolling contact with the *cast* surface of the rack shrouding at all times. The machine cut teeth also had to mesh with the *cast* rack teeth without binding or losing contact along the working faces of the teeth. Finally, the cast teeth on the rack were required to match a three-tooth template to insure accuracy of tooth contour. Meeting precision standards like these in quantity production of castings is a routine job for Birdsboro.

The moral is: Cut your fabricating costs by specifying closer casting tolerances—then put the problem of meeting those money-saving specifications up to Birdsboro's Randupson Process of Precision Casting. We will be glad to check your blueprints for possible sources of savings. Write today.

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PRECISION
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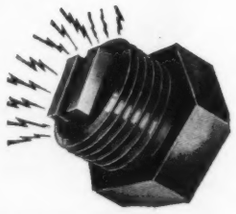

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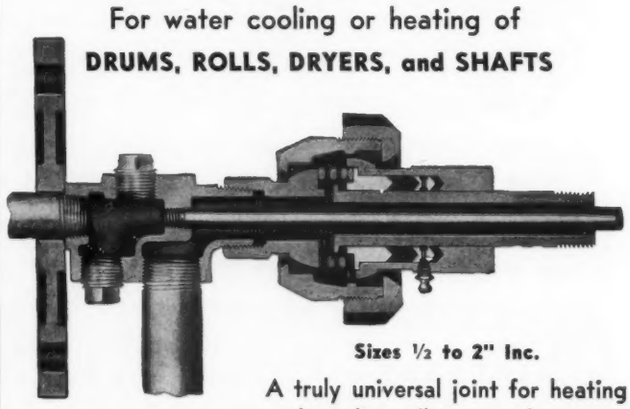

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SEND FOR CATALOGUE 291

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Left: Hanna Hydraulic Cylinder Model H. P. 17, one of ten standard models built to accommodate practically every type of mounting requirement.

Above: Hanna Hydraulic Cylinder Model H. P. 14, arranged for pivot-mounting, permitting cylinder to swing in an arc.

Below: Hanna Model 4 Air Cylinder with mounting for horizontal or vertical power movement.

Right: Hanna Model 18 Low Pressure Cylinder, designed to operate with air, oil, or water, at pressures up to 100 lbs. per sq. in. This model is equipped with a flat base for rigid mounting.

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We are equipped to meet your cylinder requirements promptly. Hanna Cylinder Catalogs, No. 229 Hydraulic and No. 228 Pneumatic, give complete details. Send for them today.

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DOES SERVICE IMPROVE WHEN YOU ECONOMIZE WITH WELDED STAINLESS TUBING?

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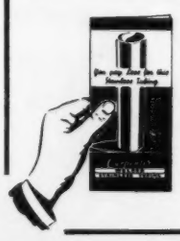
Take the illustrated cooler coil, for instance. Ten of these coils were made from Welded Stainless Tubing at a 23% saving (including all fabricating costs). No trouble was encountered in fabricating and no trouble in service. The saving was simply an extra bonus.

We know of no product using stainless tubing that cannot be made of *Welded* Stainless Tubing at a 15% to 40% saving. Why not take the first step toward getting those savings for your own product? Without obligation, we will be glad to quote prices on the sizes and gauges you need, and send you our new Welded Stainless Tubing Folder. Simply ask for your free copy in your letter.



THE CARPENTER STEEL COMPANY
WELDED ALLOY TUBE DIVISION
KENILWORTH, NEW JERSEY

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STAINLESS TUBING

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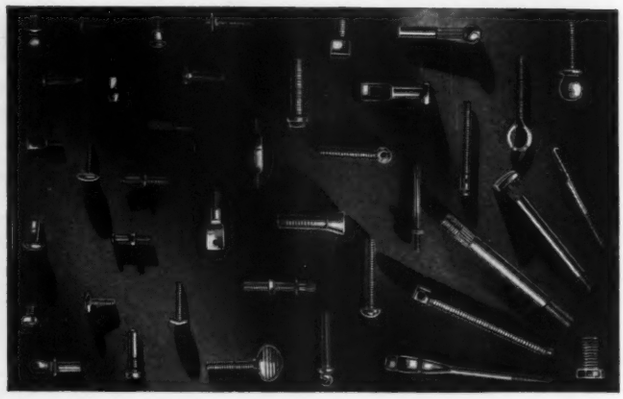

WHEN NEXT you need fastening devices requiring special heads, threads or body shapes — *and need them in a hurry* — put the job up to PROGRESSIVE. Our "specials" department is geared to produce made-to-order parts, such as those illustrated, with time-saving speed — and to undeviating high standards of uniformity, thread accuracy and great tensile strength. Submit samples or specifications for quotations.

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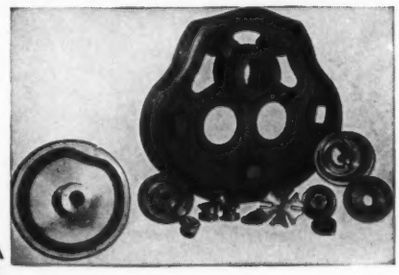

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Advertisement DECEMBER, 1940

COPPER ALLOY BULLETIN

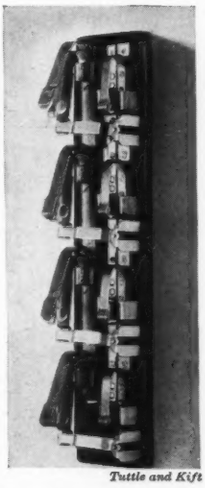
REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared Each Month by the Bridgeport Brass Co. "Bridgeport" *Headquarters for BRASS, BRONZE and COPPER*

Range Switch Parts Complete More Than Six Million Cycles

Striking proof of the superior spring quality of Bridgeport's phosphor bronze is given by the results of life tests on the switch control for electric ranges illustrated in the accompanying photograph. All spring parts in this switch are fabricated from phosphor bronze supplied by Bridgeport.

The switch was tested for a period of more than six months, and 6,408,000 cycles were completed without any sign of failure in the switch parts. Bridgeport's up-to-the-minute rolling mill facilities and careful laboratory control of processing are outstanding factors in establishing this exceptional performance record for phosphor bronze. Fabricators of spring parts for electrical or mechanical equipment can give their products greater life expectancy and the ability to withstand severe service by utilizing the superior toughness and resilience of Bridgeport Phosphor Bronze.



Tuttle and Kift

Low-Melting Alloy Used As Tube-Bending Filler

Thin-walled tubes of copper or brass can be bent successfully and without rippling by filling the tubes with Cerrobend, a low-melting alloy of bismuth, lead, tin, and cadmium, it is claimed. Cerrobend is said to be free from many of the disadvantages that have characterized previously employed filling materials. When substances such as resin, pitch, or sand are employed, it is said to be difficult to remove all traces of the filler from the inside of the tube after the bending operation is completed. Cerrobend, however, can be successfully removed, it is said, and tests are reported to prove that no alloying takes place between Cerrobend and the metal of the tube.

Cerrobend melts at about 160° F., and is said to have the unusual property of expanding instead of contracting as it cools. For this reason, it conforms closely to the interior of the tube, which can be bent much like a solid bar, it is reported. It can, of course, be used over and over again, so that costs are low.

Copper and Copper Alloys Vital In Carrying Out Defense Program

Unique Combination of Strength, Toughness, Ductility And Corrosion Resistance Accounts for Their Wide Use

Copper and its alloys are playing an essential role in the progress of the current defense program, particularly in the manufacture of ammunition. Strength, toughness, freedom from brittleness, and the ability to withstand sudden severe shocks which would destroy ordinary materials are important factors in the use of the copper alloys. They are exceptionally ductile and easy to fabricate rapidly. Moreover, they have high resistance to the effects of corrosion and weathering, and can therefore be stored for long periods of time without deterioration.

Memos on Brass—No. 16

Common High Brass, having a nominal composition of 66% copper and 34% zinc, is the most widely used copper alloy for general fabricating purposes. Its popularity is the result of the balance it achieves between initial cost and ease of fabrication. Copper-zinc alloys with a higher copper content are more expensive; those with a lower copper content are less ductile, and therefore less suited for cold working.

Mutual-Sunset Lamp Manufacturing Company

Brass knuckles are being soldered to each end of a Bridgeport seamless brass tube to form the extension arm of a bridge lamp. For this application, Bridgeport furnishes brass of extra strength and rigidity.

Probably the most important application of the copper alloys in defense is the use of cartridge brass for ammunition. Cartridge brass contains approximately 70% copper and 30% zinc. Specifications are very rigid, calling for a brass of exceptional purity. In particular, cartridge brass must be free from any appreciable amount of such impurities as iron and lead. In addition, the metal must be rolled to accurate gage and must be free from foreign inclusions, gas pockets, and surface defects. It must be annealed with a uniform grain structure and at a temperature which results in maximum ductility.

Other Copper Alloys

Another copper alloy, Commercial Bronze, containing approximately 90% copper and 10% zinc, is used for bullet jackets. (In some Government specifications, this alloy is referred to as Gilding Metal. It is more common practice in the brass industry, however, to use the term Gilding Metal to describe the 95-5 alloy.) The 90-10 alloy is also very ductile and consequently easy to fabricate into drawn work.

For the manufacture of time fuses (such as are used for shrapnel shells) brass rod, containing about 60% copper, 2% lead, and the remainder zinc, is commonly used. Time fuses are usually made from hot forgings. Pure copper is extensively used in the form of rings which are fitted into grooves in shrapnel shells. These rings or rotating shell bands seal off the powder fumes and provide a soft metal contact between the shell and the rifling of the gun. They are made either from sections of copper tubing or by blanking, cupping, and drawing the copper into the required form. The 90-10 alloy is used for this purpose also.

Communication Wire

Copper alloys also aid in maintaining telephone communication in the field. Bronze communication wire, consisting mainly of copper with a small percentage of tin, is widely used for this purpose, because it is stronger than pure copper wire and will stand considerable abuse without breaking.

While other materials have frequently been suggested for copper and its alloys in many industrial applications where physical demands are not especially severe, no adequate substitute for the copper alloys in armaments has ever been discovered. The unusual combination of properties possessed by the copper alloys is unlikely to be duplicated in other materials.

COPPER ALLOY BULLETIN

ALLOYS OF COPPER

This is the eighteenth of a series of articles on the properties and applications of copper alloys, and continues the subject of modifications of the copper-zinc alloys.

ADDITIONS OF TIN TO COPPER-ZINC ALLOYS

One of the elements commonly added to the copper-zinc alloys is tin. The principal reason for this addition is the improved resistance to corrosion, particularly where brass is subject to attack by sea water. Years ago common Muntz metal was found beneficial for protecting the bottoms of sailing vessels. Muntz metal sheathing was used in preference to copper because the gradual dezincification of the Muntz metal prevented the growth of barnacles. The addition of tin to Muntz metal decreased the rate of corrosive attack, while preventing formation of marine growths.

Admiralty Condenser Tubes

Ultimately this effect of tin was used advantageously in condenser tubing. Experience had shown the advantages of the 70-30 copper-zinc alloy over the 60-40, and the addition of 1% tin to the former alloy brought about an equally satisfactory improvement. The alloy containing 70% copper, 29% zinc, and 1% tin was originally the mixture adopted by the British Admiralty for condenser tubing, and hence became known as Admiralty. This alloy was first manufactured in this country by Bridgeport.

The addition of tin seems to prevent dezincification. This effect was first noted in the alpha plus beta Muntz metal and was ascribed chiefly to the added resistance of the beta crystals. When added to the 70-30 alloy, tin proved equally helpful to the alpha crystals.

Tin in Other Alloys

Some attempts have been made to improve the corrosion resistance of red brass by the addition of tin, but since the red brass has little inherent tendency toward dezincification, any beneficial effect due to to the tin is not readily apparent.

Tin is added to the richer copper-zinc alloys because of its effect on the color and because of the slightly increased strength it gives to the alloy. Such additions are not common because very similar effects can be produced by a simple increase in the zinc content. The presence of tin tends to whiten slightly the normal golden color of the 85-90% copper alloy, and is useful in the jewelry trade when exact matches of color are necessary.

Switch Contacts Emit Arc-Extinguishing Gas

A novel means for extinguishing arcs in switches and circuit breakers designed to open under load, without the use of mechanical devices, is described in a recent patent. The arc is extinguished, it is claimed, by the emission of gas from the contacts under the heat of the arc.

The contacts, according to the patent, may consist of copper or copper alloys. The contacts are made porous by mixing a quantity of finely divided particles of the copper or alloy with an organic binder, such as soap. The mixture is compressed into a composite mass, and heat is used to volatilize the soap and bond the metal. The contact is immersed in oil or water, and the liquid fills the voids in the sponge-like mass. When the circuit is interrupted, the vapor formed by the heat of the arc acts quickly to extinguish it, it is claimed.

Pressures Given for Cold Squeezing Steps

Suggested pressures for use in determining needed press capacity for typical cold squeezing operations were listed as follows in a recent issue of *Modern Industrial Press*.

OPERATION	TONS PER SQUARE INCH
Coining bronze	90–100
Embossing brass	175–215
Cold forging brass	15–30
Swaging brass	60–70
Swaging copper	70–80

Bronze, Rubber Used In Flexible Bearings

Flexibility in a new type of bearing is obtained by bonding a ring of neoprene or rubber between inner and outer rings of brass or bronze, it is reported. It is said that the bearings can be made in sizes to specification, and in lengths up to four feet, which can then be cut to length as required.

Bridgeport will refer readers to the manufacturer of the bearing.

NEW DEVELOPMENTS

Vertical screw-cutting machines, which were developed abroad, have been placed on the market in this country, it is reported. Outstanding advantages claimed for the vertical machines are reduction in floor space and feeding of stock by its own weight. It is said that the machines also operate more quietly. **(No. 140)**

A comparator-densitometer is described as a simple, compact device for measuring the density of lines on spectrogram plates. It is said that the instrument provides means for projecting spectrogram on a viewing screen, and for quickly identifying the spectral lines of 70 elements. **(No. 141)**

A scrap cutter is designed for cutting punch press scrap to predetermined lengths, can be used also for cutting finished products to length, according to the maker. It is said that the cutter can be set to operate at any given number of strokes of the press. **(No. 142)**

A tap and reamer aligner is said to be accurately machined to permit quick, perfect alignment of tap or reamer over drilled hole. **(No. 143)**

A stripping compound removes baked enamels, varnishes, lacquers, paints, and synthetic finishes from metal, it is claimed. Action, it is said, depends on an emulsifying effect that floats away the coating, leaving a clean, bright metal surface. Compound is reported to contain no caustics. It is furnished in concentrated form for dilution with water. **(No. 144)**

A sulphur-carbon compound is described as suitable for checking impressions of forging dies and die-casting dies. It is said that the new material is very light, does not shrink, shows the finest markings of the form or die. It can also be used in place of wood patterns, it is claimed. **(No. 145)**

A polisher's brick is recommended by the maker for removing oil or grease from wheels before they are reset with abrasive. It is said that the brick is suitable for use on wheels employed for finish polishing. **(No. 146)**

A production marker is said to be designed for high-speed identification of round tubular or solid metal parts, such as shells, venturi tubes, and many other products. It is said that the machine is motor-driven, and is automatic except for hand feeding of parts to gravity chute. Speeds up to 7,000 pieces per hour are possible, it is claimed. **(No. 147)**

A cut-off machine is said to assist in high-speed production of parts of the type made on automatic screw machines. The machine, it is claimed, can perform the following operations or combinations: stock feed to fixed or swinging stop, form and cut off with two cross slide tools, and one or two end operations, such as threading or drilling. **(No. 148)**

This column lists items manufactured or developed by many different sources. Further information on any of them may be obtained by writing Bridgeport Brass Company, which will gladly refer readers to the manufacturer or other source.

PRODUCTS OF THE BRIDGEPORT BRASS COMPANY

Executive Offices: BRIDGEPORT, CONN.—Branch Offices and Warehouses in Principal Cities

SHEETS, ROLLS, STRIPS—*Brass, bronze, copper, Duronze,** for stamping, deep drawing, forming and spinning.

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PHONO-ELECTRIC* ALLOYS—High-strength bronze trolley, messenger wire and cable.

WELDING ROD—For repairing cast iron and steel, fabricating silicon bronze tanks.

LEDRITE* ROD—For making automatic screw machine products.

"Bridgeport" BRASS CO. *Established 1865*

COPPER WATER TUBE—For plumbing, heating, underground piping.

DURONZE ALLOYS—High-strength silicon bronzes for corrosion-resistant connectors, marine hardware; *hot rolled sheets* for tanks, boilers, heaters, flues, ducts, flashings.

BRASS, BRONZE, DURONZE WIRE—For cap and machine screws, wood screws, rivets, bolts, nuts.

FABRICATING SERVICE DEPT.—Engineering staff, special equipment for making parts or complete items.

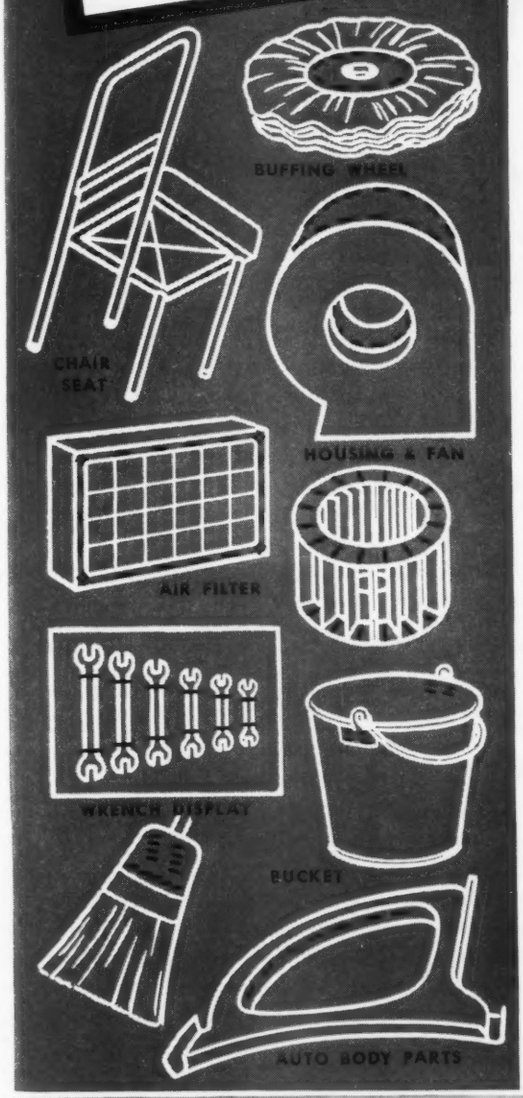
BRASS AND COPPER PIPE—"Plumrite"* for plumbing, underground and industrial services.

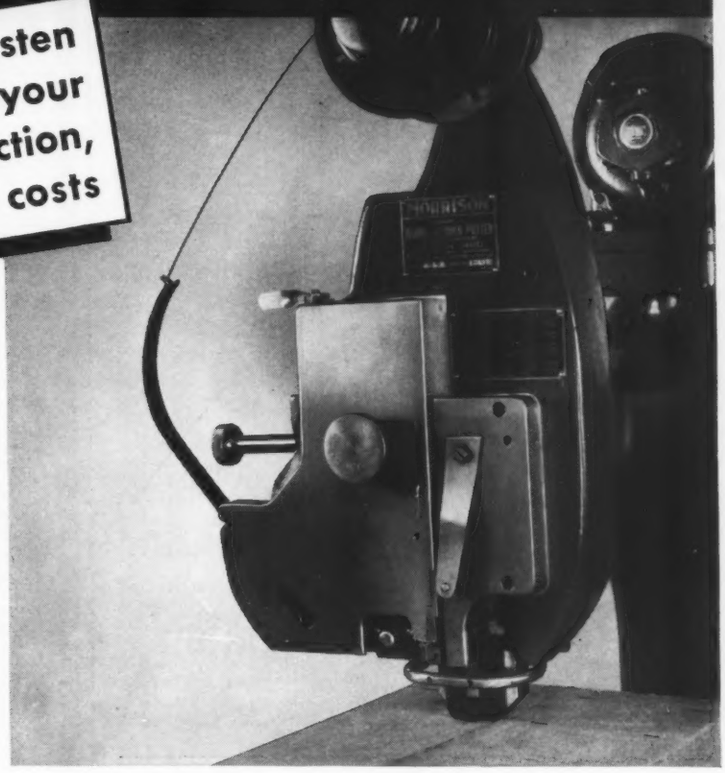
*Trade-name.

BRIDGEPORT BRASS

Find out NOW!

How this new way to fasten materials may improve your product, speed up production, and help reduce your costs





The new way to fasten materials together is Morrison wire stitching. For many products it is better, faster and cheaper than older usual fastening methods.

Morrison stitches, formed from a spool of wire, cost only a fifth as much as rivets, and stitching is often three to four times faster than either riveting or welding. In some cases, wire stitches hold more securely than spot welds.

Hundreds of products are being made today with wire stitching an integral part of design and manufacture. Do not overlook the savings and the product improvement Morrison may make possible for you.

Please send samples of your work or indicate your fastening problems when you write for the facts and figures on Morrison Wire Stitching.

SEYBOLD DIVISION, Harris-Seybold-Potter Co.
847 Washington Street • Dayton, Ohio

Above is the new Morrison with revolutionary SL-type head which can be furnished with top speed of 500 RPM. Below is the Morrison Steel Stitcher which readily drives a wire stitch through two sheets of 20 gauge steel.

MORRISON

WIRE STITCHING MACHINES

Address inquiries:-

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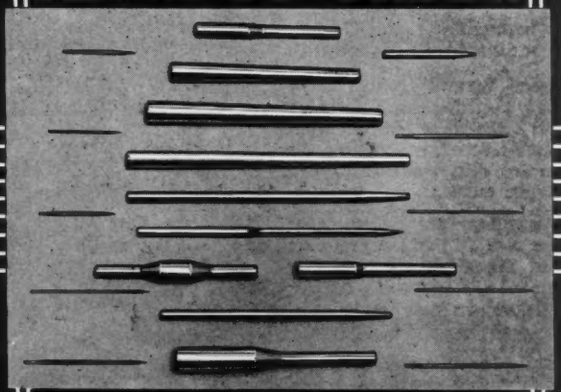


Tubes, Rods, Wire reduced by rotary swaging to your specifications by the pioneer rotary swaging machine builder.

Cuts show various tubes reduced, tapered and closed on end by swaging. Solid work up to 5/8" diameter and medium wall tubing up to 2 1/2" O. D. can be handled.

You benefit from our nearly seventy years' rotary swaging experience.

The Torrington Company

SPECIALTY DEP'T.

Torrington, Conn., U.S.A.

WHY CORPRENE

What is CORPRENE?

"CORPRENE" is Armstrong's name for a group of more than two dozen cork-and-synthetic-rubber compositions—made in sheets, cut pieces, and molded forms. They've proved to have hundreds of profitable uses. Millions of Corprene gaskets and packings are now licking tough sealing problems in modern industrial equipment. Corprene and cork-rubber sheets are being used for airplane wingwalks, glazing strips, and sound-and-vibration-damping units. Molded forms make ideal oil seals, feed rolls, friction handles, valve discs. There's a Corprene composition available from Armstrong for almost any industrial application which requires a material having the desirable characteristics both of cork and of various synthetic rubbers.

GENERAL CHARACTERISTICS OF CORPRENE

1. *Corprene is impervious* to liquids and gases and resistant to their destructive effects.

2. *Corprene resists* the deteriorating influences of both sunlight and corona.

3. *Corprene's sealing efficiency* enables it to handle many jobs too tough for ordinary materials.

4. *Corprene's specific properties* differ greatly according to composition type. For example, there are high and low degrees of compressibility and lateral flow—and coefficients of friction range from very low values to one and one half times that of natural cork. How such properties can be controlled is illustrated on the opposite page.

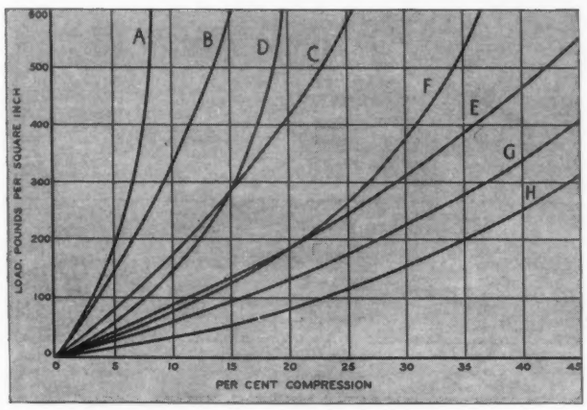
Armstrong's

COMPOSITIONS OF CORK

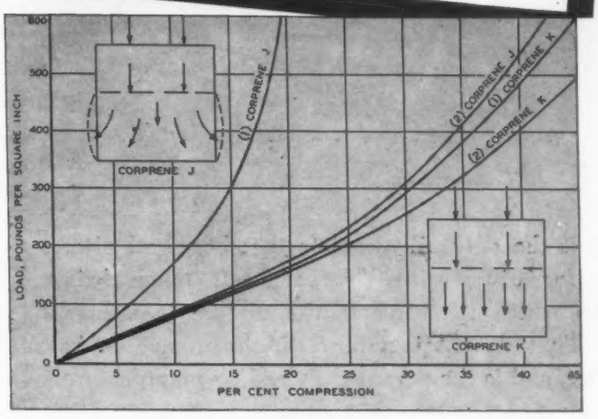
MAKES TOUGH PROBLEMS EASY

Corprene's Properties Can Be Controlled to Meet Your Requirements

Corprene comes in more than 25 standard compositions, which meet practically all sealing and "special use" needs. In addition, Corprene's unique combination of properties can be "tailor-made" to fit your specific requirements. Its compressibility, lateral flow, chemical and solvent resistance, coefficient of friction, hardness, and tensile strength are available in a wide variety of ranges—each controlled within narrow limits.

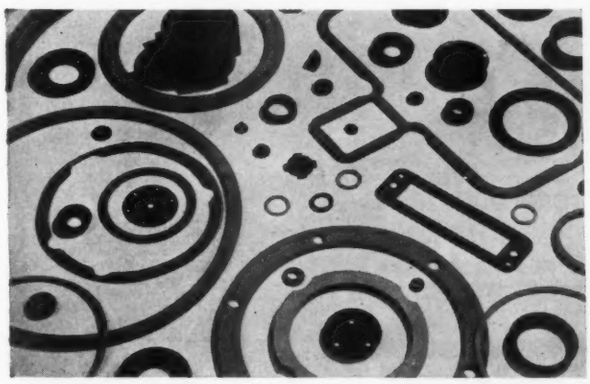


CONTROLLED COMPRESSIBILITY: *This chart shows typical compression curves, as they result from formula variations, of several Corprene compositions. A wide range of compressibilities is available—each controlled within narrow limits. Other properties can be controlled similarly.*



CONTROLLED LATERAL FLOW: *Deflection curves of two typical Corprene compositions, each of the same Shore hardness—as they compress (1) with all sides confined, (2) with vertical sides unconfined—illustrating how some Corprenes are truly compressible, others only partially so.*

Typical Corprene Units Which Are Serving American Industry Today



SEALING TROUBLES VANISH *when Corprene gaskets and packings go to work. The samples above are scant representation of the thousands of types of Corprene seals in use today. We cut and mold pieces from more than two dozen Corprene compositions, having widely varied properties.*

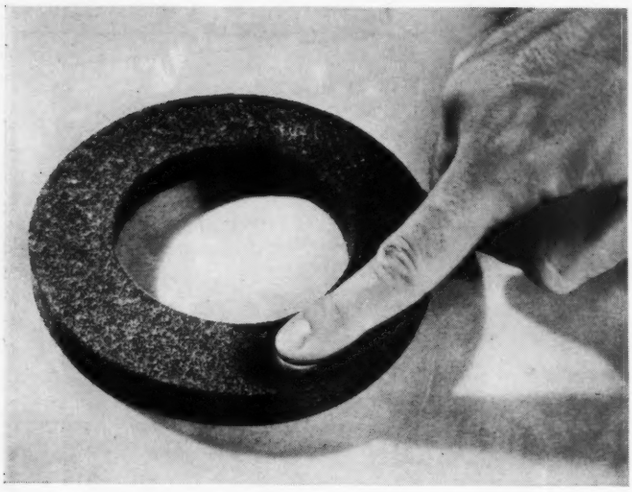
NOISE IS NO PROBLEM *when you use anti-squeak tape, glazing and sealing strips, and sound-and-vibration-damping units made of Armstrong's Corprene and cork-rubber compositions. Friction is sure with feed rolls, airplane wingwalks, handles, golf grips, and anti-skid pads.*

CORPRENE

AND RUBBER-LIKE MATERIALS

The chances are that, in one of the more than two dozen Corprene compositions available, we have just the material you need. What are your requirements for samples? Armstrong Cork Company, Industrial Division, 907 Arch Street, Lancaster, Pa.

THE "BLUSH" THAT MEANS... BALL BEARING INSURANCE!



FELT is the only oil reservoir that holds oil always ready for distribution. The slightest touch brings friction which wicks oil to the surface in a bright pool. That "blush" is never-failing insurance for ball bearings, and is the reason why leading manufacturers depend on AMERICAN FELT Washers, made to their *precise* specifications, to insure lifetime satisfaction to users of their ball bearings. In addition to vast quantities of washers, which are saturated with oil and sealed within bearing assemblies, we supply large quantities of wicks. We will deliver cut parts to your *precise* specifications *exactly* when you want them. You can depend on our two sources of supply, *i.e.*, modern cutting shops at Detroit, Mich., and at Port Chester, N. Y., manned and managed by men who *know* FELT and how to convert it. Please write for Data Sheet No. 6, Felt and Lubrication.

American Felt Company

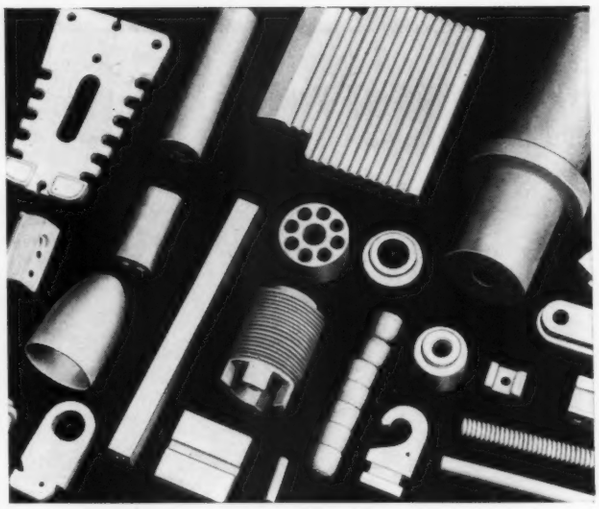
TRADE MARK

General Offices: GLENVILLE, CONN.

Plants at Glenville, Conn., Newburgh, N. Y., Franklin, Mass., City Mills, Mass., Detroit, Mich.

Sales Offices at New York—Chicago—Philadelphia—Boston—Cleveland—Detroit—St. Louis

PRODUCERS OF FINEST QUALITY PARTS FOR OIL RETAINERS, GREASE RETAINERS, WICKS, DUST EXCLUDERS, GASKETS, INSULATING FELTS, CHANNEL FELTS, UPHOLSTERY RISER STRIPS, BODY SILENCING PARTS, DOOR MECHANISM GASKETS, AND BODY POLISHING WHEELS



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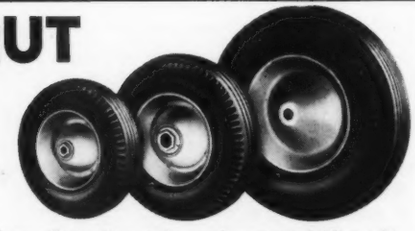
DOENUT WHEELS with OUTSIDE VALVE



Preserve floors, reduce effort, stop noise and prevent jolting with this new Doenut wheel with outside valve. Unexcelled for handtrucks, wheelbarrows, cylinder trucks, greasing equipment, and other types of mobile units. No matter how carelessly tire is allowed to run under-inflated, valve cannot be cut or damaged by "creeping". Punctures repaired without removing tire from rim.

Available in three sizes—10"x2.75"; 12"x3.30"; 16"x4.40". Doenut Wheels developed by originator of the airwheel for airplanes. In writing kindly give axle size and maximum load per wheel.

MUSSELMAN PRODUCTS CO.

6308 ST. CLAIR AVE. CLEVELAND, OHIO

To RESIST WEAR on VITAL PARTS

CARBOLOY

*Carboloy Cemented Carbide provides up to 100 times longer life than ordinary metals when subject to abrasion and certain forms of corrosion. You simply braze in a piece of Carboloy at point of wear, or replace with solid Carboloy part. Supplied in any shape desired. Often a practical, economical solution to problems of wear on vital parts of equipment, machinery or other products.

Write for Booklet WR-101

CARBOLOY COMPANY, INC.

11123 E. 8 Mile Road, Detroit, Mich.

Chicago—Cleveland—Newark—Pittsburgh—Philadelphia—Worcester, Mass.

Thank You, MR. MANUFACTURER

SHELBY TUBING **is made by master craftsmen by the seamless process. Billets of finest quality steel are first pierced, then precision-rolled to close tolerances inside and out. Thorough inspections and tests, all along the line, assure that only tubing that's as near perfect as it's possible to produce will receive the name "SHELBY."**

1.—for recognizing the unsurpassed quality of Shelby Seamless Tubing.

Back in the days when tube-making was a relatively new art, SHELBY emerged as the leader in the field. Engineers, designers, and machinists quickly found that no other tubing offered the same uniform, flawless strength or the same easy machining qualities, length after length, as SHELBY.

2.—for making it the most honored and most widely used tubing.

From that early beginning, makers of SHELBY have never relaxed their rigid requirements, have constantly striven to keep the name SHELBY a symbol of tube quality. The result: SHELBY is now a standard tubing specification everywhere—the most widely used tubing in the world.

3.—for encouraging us to continue the search for ways to make Shelby even better.

Makers of SHELBY are pledged to do more than maintain present standards of excellence. They promise to extend the chain of progress, to search out ways and means of producing tubing that even better meets your requirements, to make each year's production better than the last—stronger, more uniform, more accurate, easier to machine—always a step ahead.

STOCKED BY "GILT EDGE" DISTRIBUTORS

SHELBY *distributors throughout America are specially selected to provide a complete source of supply and experienced service. You can rely on them on all matters concerning tubing application.*

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* • United States Steel Export Company, New York

UNITED STATES STEEL

SUCCESS STORY

THEY LICKED
THE PROBLEM OF
WEAR
. . . Longer Service Brought Lower Costs
The spacers in a tin sheet feeder are subject to extreme wear. One mill reports that no steel spacers had ever lasted more than 3½ months. But when spacers made of AMPCO METAL, Grade 22, were installed, they showed no wear in over a year of service!

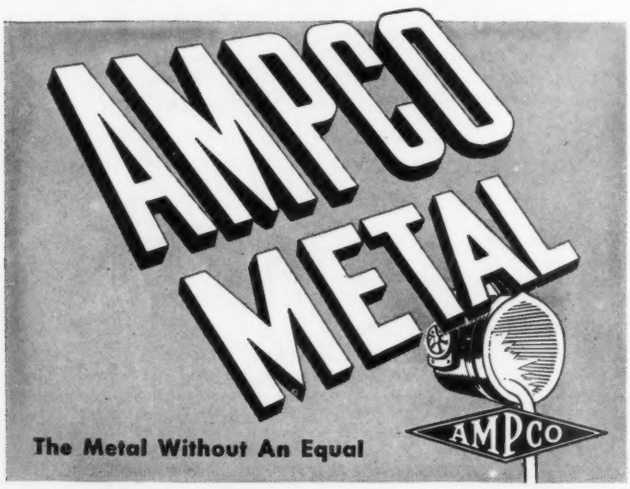
Which Is Only One Example

of the phenomenal savings and stepped-up performance that often follow a switch to AMPCO METAL . . . There's nothing else like this remarkable bronze in its resistance to wear and "squashing" under impact — its resistance to fatigue, stress and corrosion — the extreme hardnesses available.

IF YOU HAVE A PROBLEM

caused by *"metal failure"* in some part of your product or production tools—why not give AMPCO METAL a trial? It is noted for making good where other metals fail. Explain your problem to our metallurgists. We will offer recommendations and complete data.

AMPCO METAL, INC., Dept. PE-12, Milwaukee, Wis.



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Contain complete physicals and instructions for treatment on all Allegheny Ludlum Steels. A request on your letterhead will bring this information without obligation. Our Laboratory and Metallurgical Departments are prepared to render every possible assistance and cooperation.

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JESSOP
NON-MAGNETIC STEEL

A Uniform high quality steel possessing:
LOW MAGNETIC PERMEABILITY
HIGH ELECTRICAL RESISTANCE
GOOD MACHINING QUALITIES

SEND FOR YOUR FREE COPY
This new bulletin fully describes the physical and electrical properties of JESSOP NON-MAGNETIC STEEL, of special interest to those concerned with the design or production of electrical equipment. Write JESSOP STEEL CO., 573 Green St., Washington, Pa., for your copy—no cost or obligation.
Metal piece at right is magnetic iron, that at left is Jessop Non-Magnetic Steel. Both are attached to an electro-magnet. Note that lines of force, shown in iron filings, are all directed to iron sample at right.

JESSOP STEEL COMPANY
General Office and Works
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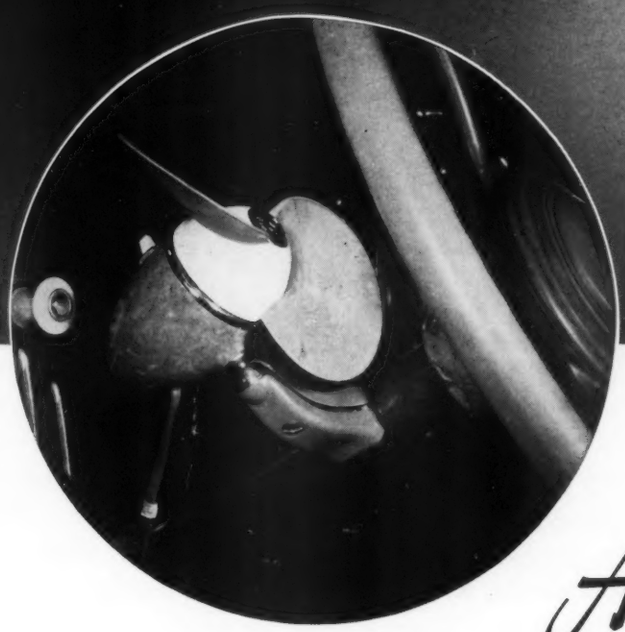
Jessop Steels of America
CARBON- HIGH SPEED- SPECIAL ALLOY- STAINLESS- and COMPOSITE STEELS

DURITE

Clears the Air!



ALMOST everything but the rubber blades on this fan* is made of sleek tan and brown Durite. As the fan keeps the windshield clean of moisture and circulates fresh air through the interior of the car, the streamlined Durite housing withstands the twin strains of heat and electricity without faltering. The finish is integral with the article itself, will never peel, chip, dent or fade.

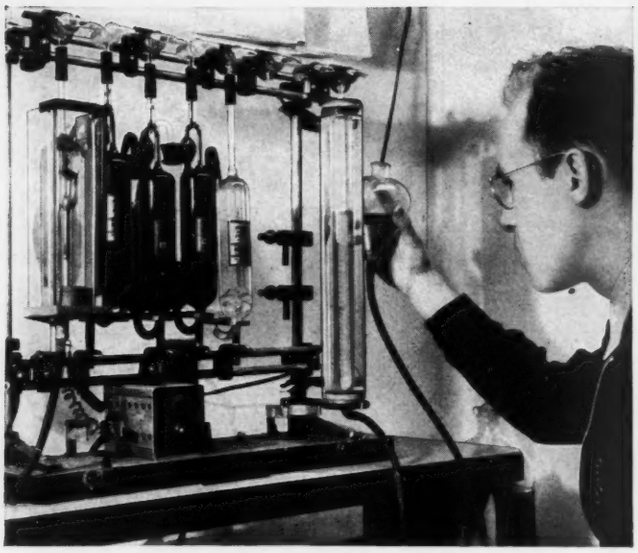
This is another of the many applications of beautiful, strong Durite—the only phenol-furfural plastic.

**DURITE PLASTICS*

REG. U. S. PAT. OFF.

FRANKFORD STATION, P. O., PHILADELPHIA, PA.

**Molded by: The General Industries Co., Elyria, Ohio*



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a 1 5/8" draw from a flat sheet

Retaining its beautiful, continuous surface lustre through deep draws and severe sterilization, Color-Cote has made paint history. Applied by brush, spray, dip or roller, Color-Cote works easily, covers perfectly and dries to a brilliant, modern finish . . . If you have a metal coating problem, write to Watson-Standard for a "tailor-made" solution and a sample to prove it . . . This will save you time—and money.

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EVERDUR

THE TEN-POINT METAL OF A THOUSAND USES

A TIN-FREE, HIGH-STRENGTH, COPPER-SILICON ALLOY
With an Outstanding Record of Dependable Performance

Here is a metal that represents true economy. Moderate in price, readily adaptable to a vast number of industrial needs, Everdur is a decidedly economical metal to use. Because of this, it has won an enviable position in practically every field of engineering and manufacture.

- Everdur was developed for engineering uses requiring a metal with a tensile strength comparable to that of steel, and the corrosion resistance of copper.
- It is a strong, tough, workable and durable metal and can be cast, machined, drawn, rolled, spun, stamped and forged.
- Its high endurance limit makes it exceptionally valuable for many applications involving excessive vibration.
- Strong, tough, dense welds can be made readily by the usual welding methods —oxy-acetylene torch, carbon or metallic arc, or resistance welding.
- For screw machine and turret lathe production, free-cutting rods in conventional shapes are available from stock.
- Tin-free, high-strength castings can be made from Everdur Ingots with regular brass and bronze foundry equipment.
- Its non-magnetic property overcomes the handicaps imposed by stray magnetic fields in the manufacture of some types of electrical equipment.
- Everdur holds a fifteen-year record of dependable performance on tasks where other metals failed in a relatively short period.
- This non-rust, trade-marked, Anaconda Alloy is produced in four standard compositions, and in all standard commercial forms.
- Considering its many desirable properties, Everdur has rightfully been called a "Premium Metal at a Moderate Price".

ANACONDA
from m[illegible] sumer
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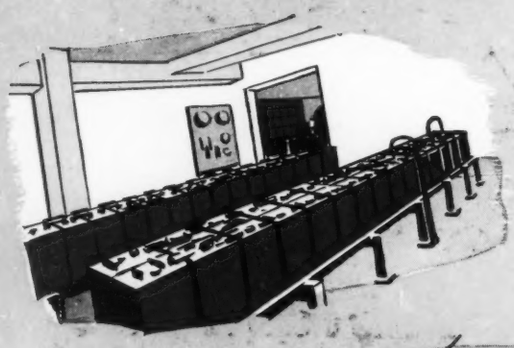
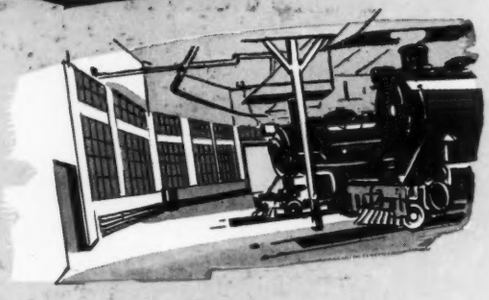
Review the partial list of its applications on the following pages, then let our Technical Department help you to determine where Everdur can do a better, more dependable job—for less money in the long run.

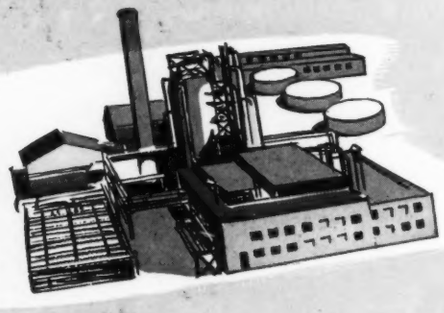
Anaconda Copper & Copper Alloys

Everdur Metal

has what it Takes to resist corrosive liquids, gases and vapors







Do these successful uses of Everdur suggest a possible solution to some intricate or trouble-some metal problem in your plant?

BATTERY AND PLATING ROOMS —PICKLING EQUIPMENT

Ducts, electrical conduit, baskets, bolts, drains, dryers, sludge lines, tumbling barrels, wire brushes.

RAILWAY EQUIPMENT —LOCOMOTIVE ROUNDHOUSES

Air conditioning and signal equipment, water tanks, ice bunkers, hardware, electrical conduit, welding rods.

OIL FIELDS AND REFINERIES

Chain, bolts, cable, agitator tanks, condenser and heat exchanger tubes and plates, conduit, sludge lines.

BRIDGES—ENGINEERING STRUCTURES

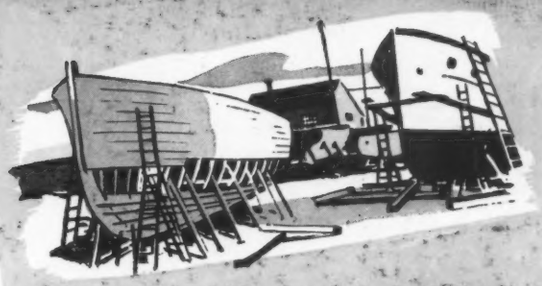
Bridge plates, bolts, tie rods, rivets, electrical conduit, castings, angles, channels, framing members, shafting.

Everdur is a trade-mark of The American Brass Company Reg. in the U.S. Pat. Off.

***EVERDUR METAL *is produced solely by* THE AMERICAN BRASS COMPANY**

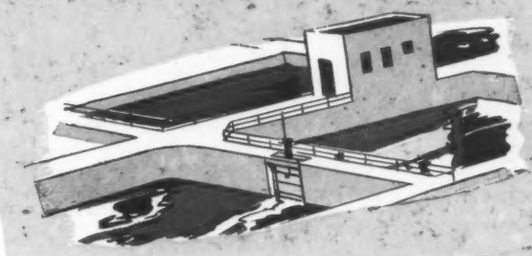
MARINE FIELD—DOCKS—SHIPYARDS

Fuel tanks, marine hardware, wood and lag screws, bolts, and other forged, cast or machined fittings.



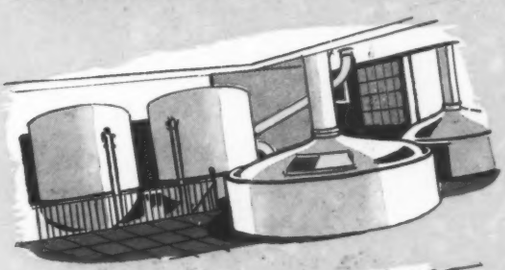
SEWAGE TREATMENT PLANTS—WATER WORKS

Screens, gates, baffles, fittings, weirs, filters, frames, tanks, bars, anchors, valve stems, bolts, man-hole steps.



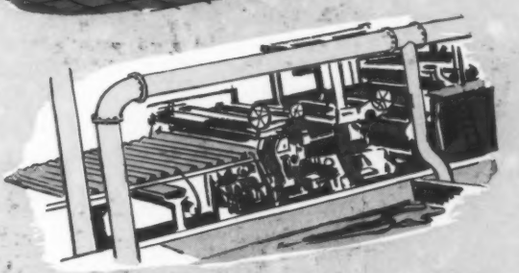
BREWERIES—DISTILLERIES—DAIRIES

Kettles, vats, filters, screens, hop strainers, wort pans, process tanks, electrical conduit.



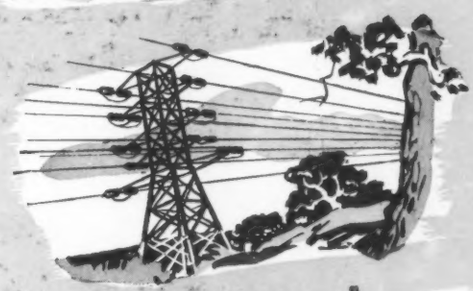
PULP AND PAPER MILLS

Carrying lines, fabricated and welded fittings, pulp knotters, screens, doctor blades, save-all pans, electrical conduit.



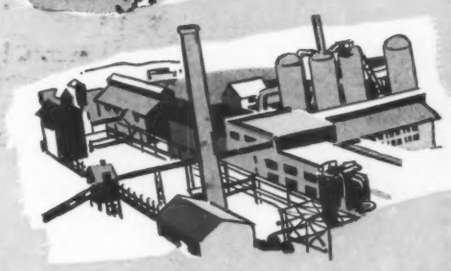
ELECTRICAL EQUIPMENT—POLE LINE HARDWARE

Circuit breakers, screws, bolts, nuts, washers, rivets, studs, clamps, springs, sockets, U bolts, eye bolts, turnbuckles, and many other accessories.

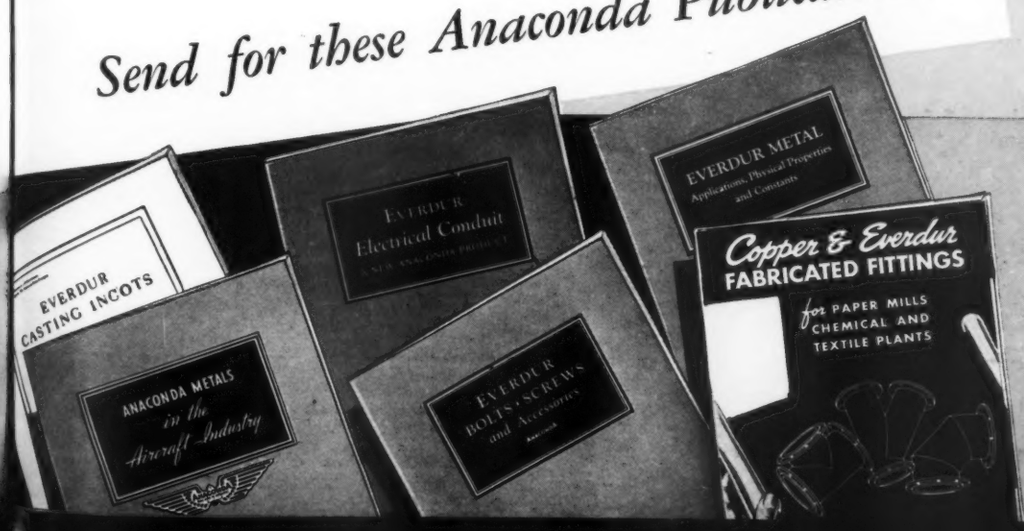


CHEMICAL AND PROCESS INDUSTRIES

Pipe lines, kettles, stills, welded fittings, valves, unfired pressure vessels, pumps, storage tanks, electrical conduit, evaporators.



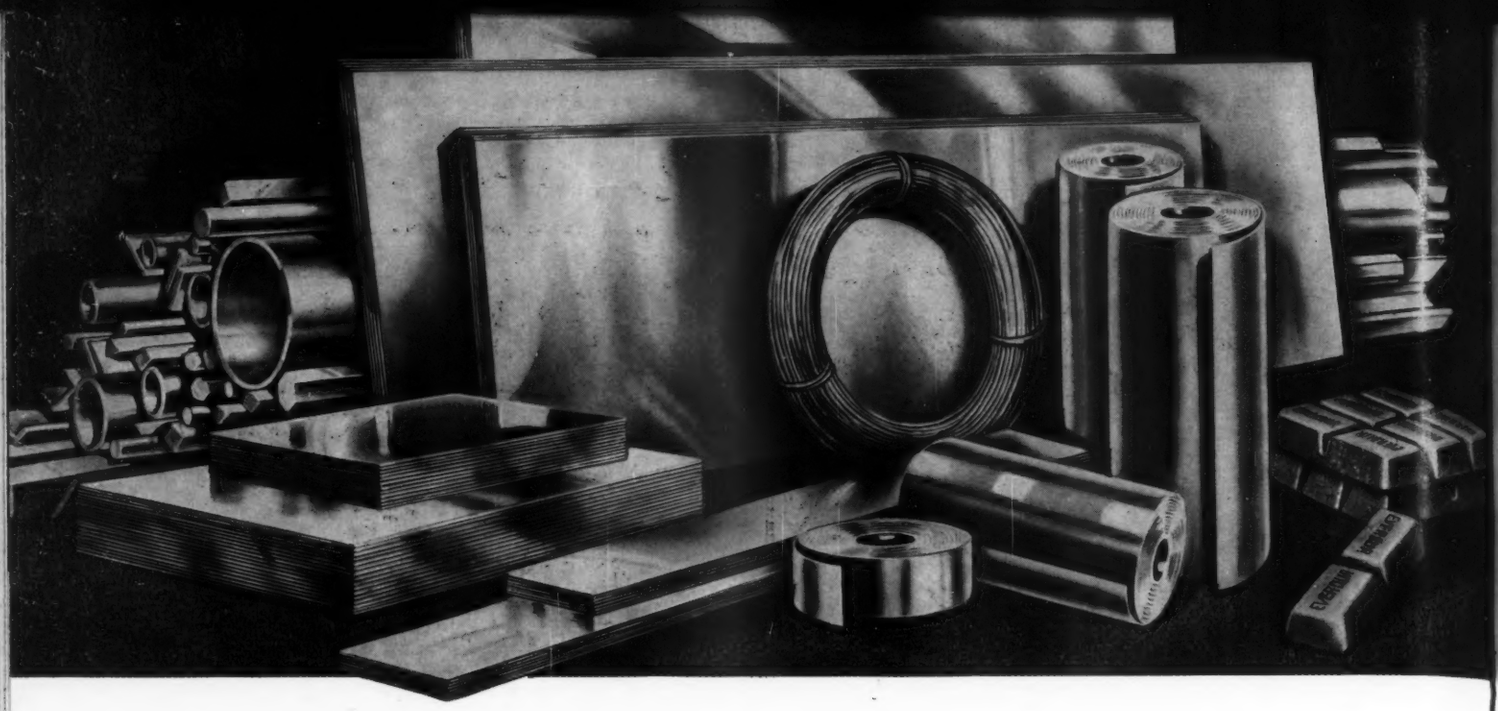
Send for these Anaconda Publications


EVERDUR CASTING INGOTS
EVERDUR Electrical Conduit
EVERDUR METAL Applications, Physical Properties and Constants
ANACONDA METALS in the Aircraft Industry
EVERDUR BOLTS, SCREWS and Accessories
Copper & Everdur FABRICATED FITTINGS for PAPER MILLS CHEMICAL AND TEXTILE PLANTS

For additional information on Everdur Metal, write for any or all of these booklets. They are available without cost. Address:

The American Brass Company,
General Offices, Waterbury, Conn.

E-5 Applications, Physical Properties and Constants
E-1 Casting Ingots—Foundry Practice and Procedure
B-22 Anaconda Electrical Conduit
E-9 Fabricated and Welded Fittings
E-6 Bolts, Screws and Accessories
B-31 Anaconda Metals in the Aircraft Industry



All these commercial forms—and more

make possible economical assembly of ALL-EVERDUR engineering structures

Everdur Metal is produced by The American Brass Company in the form of Sheets, Strips, Plates, Wire, Rods, Bars, Shafts, Tubes, Shells, Pipe, Hot Pressed Parts, Drawn Shapes, Angles and Channels, Casting Ingots and Special Products. It is also fabricated into many finished forms which can be obtained from leading manufacturers.

Everdur Metal is regularly furnished in these four principal compositions.

	Copper %	Silicon %	Manganese %	Lead %
Everdur 1010	95.80	3.10	1.10	..
Everdur 1015	98.25	1.50	.25	..
Everdur 1012	95.60	3.00	1.00	.40
Everdur 1000*	94.90	4.00	1.10	..

*Casting Ingots Only.

...and a Special Service

Service Engineers of The American Brass Company are prepared to cooperate in the solution of special metal problems. Their practical experience in many branches of the metal industry frequently enables them to determine the one best metal for a specific application, and the correct procedure for its fabrication. Your inquiries will receive the close attention of trained, experienced production and technical staffs. This service is maintained for your convenience and its use entails no obligation.

ANACONDA
from mine to consumer
REG. U.S. PAT. OFF.

THE AMERICAN BRASS COMPANY

General Offices: Waterbury, Connecticut • Subsidiary of Anaconda Copper Mining Company

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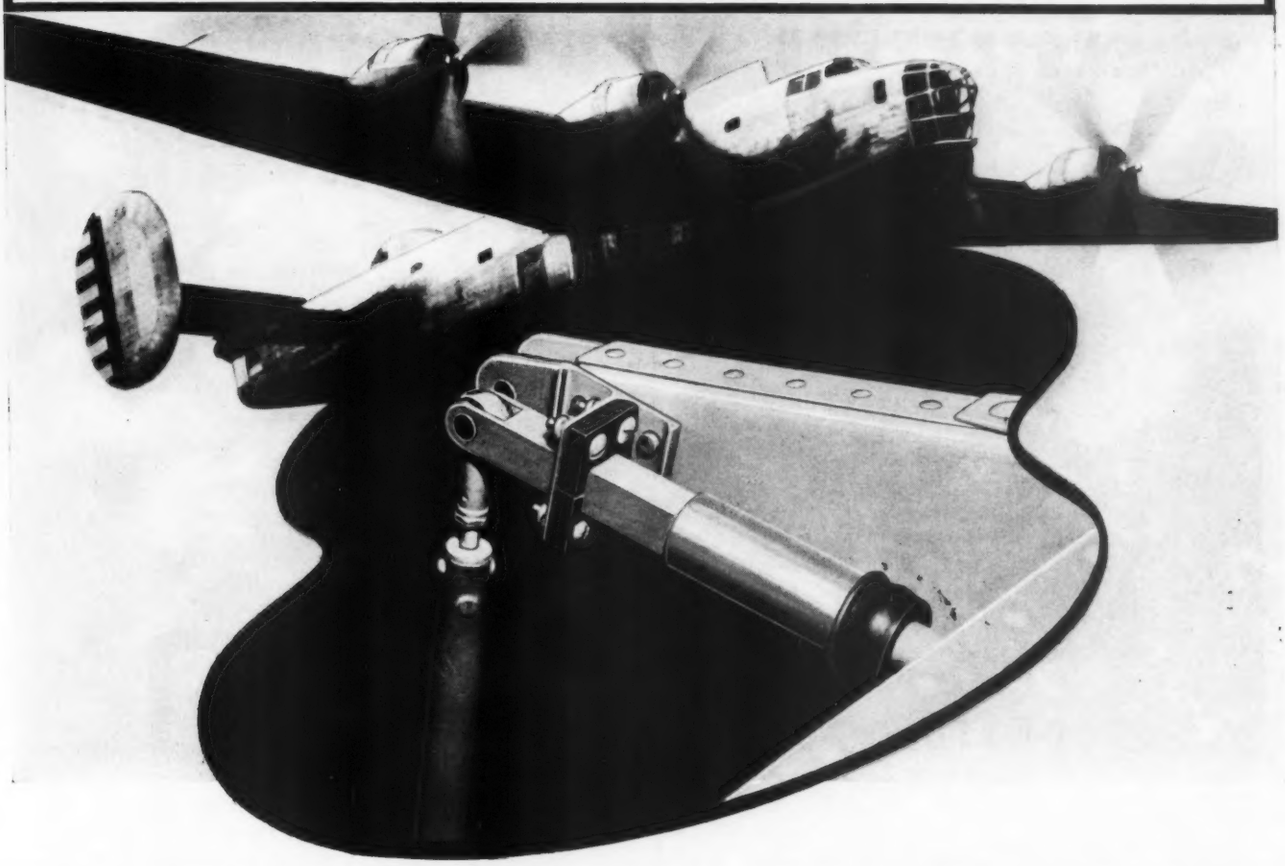

INSUROK

● In this U. S. Army B-24, four-engined land bomber . . . as in every unit of our national defense . . . the most exacting standards must be met to insure precision operation and completely dependable performance. Typical of the care exercised in the selection of all materials is the choice of INSUROK for the bearing guide illustrated. Here INSUROK, the precision plastic, is used to guide a link in the rudder tab control.

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INSUROK is available in sheets, rods and tubes; in grades and thicknesses to meet the requirements of the airplane industry. It can be fabricated without special tools in your own shop, or supplied by Richardson in finished parts and products, ready for assembly.

Information and technical data on request.

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The RICHARDSON COMPANY

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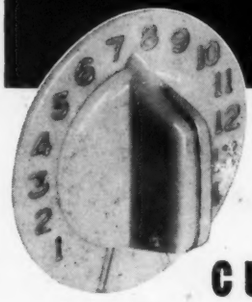
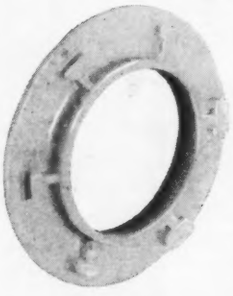
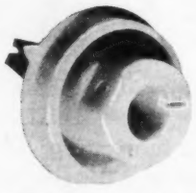


Erie

CUSTOM MOLDED PLASTICS





Erie Injection Molded Refrigerator Cold Control

The efficiency and economy of any molded article is determined to a large extent in the drawing board stage. For this reason Erie has an engineering department that KNOWS plastic molding from every angle. Very often they can suggest minor design changes that result in lower molding costs without sacrificing functional efficiency.

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The services of this design and engineering department are available for consultation with product engineers without obligation. If you are contemplating a new plastic article or changing over an existing product to molded plastics from another material, these men can be of valuable assistance to you.

Plastics Division
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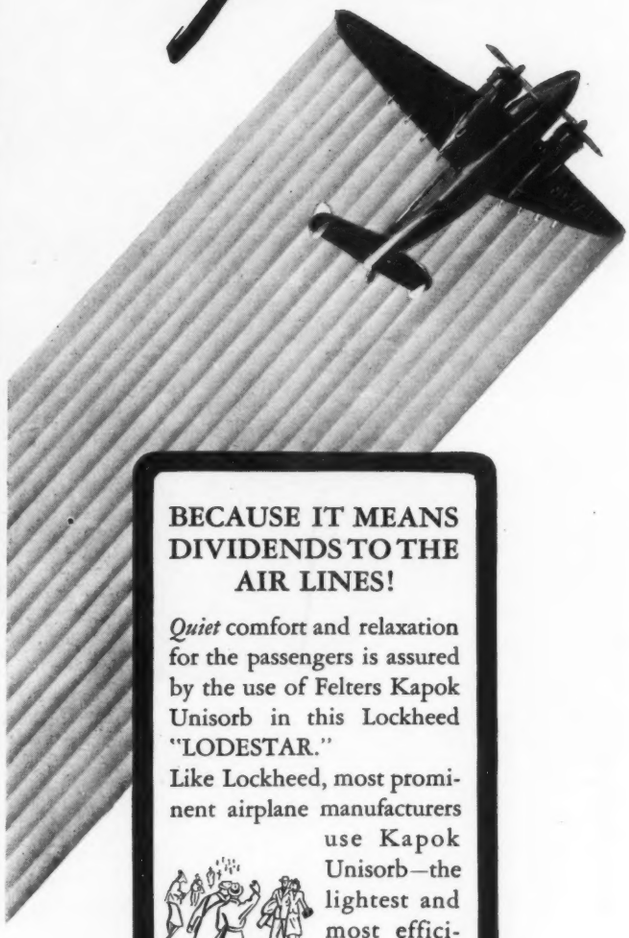

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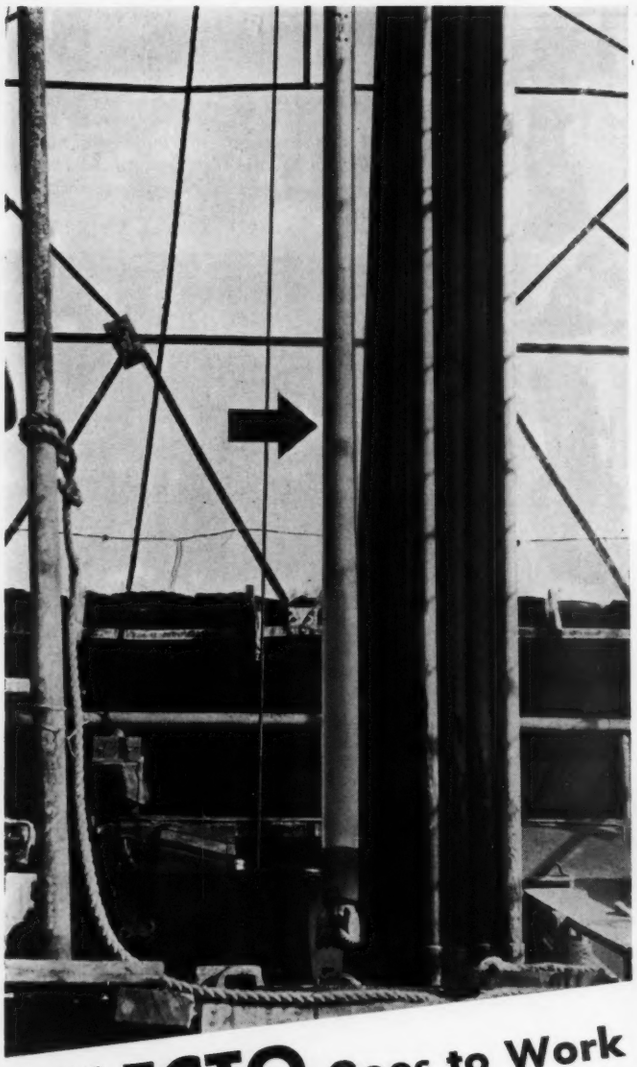

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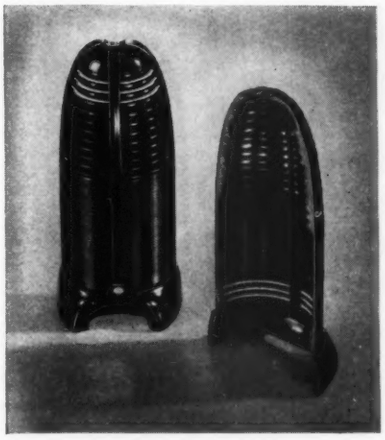

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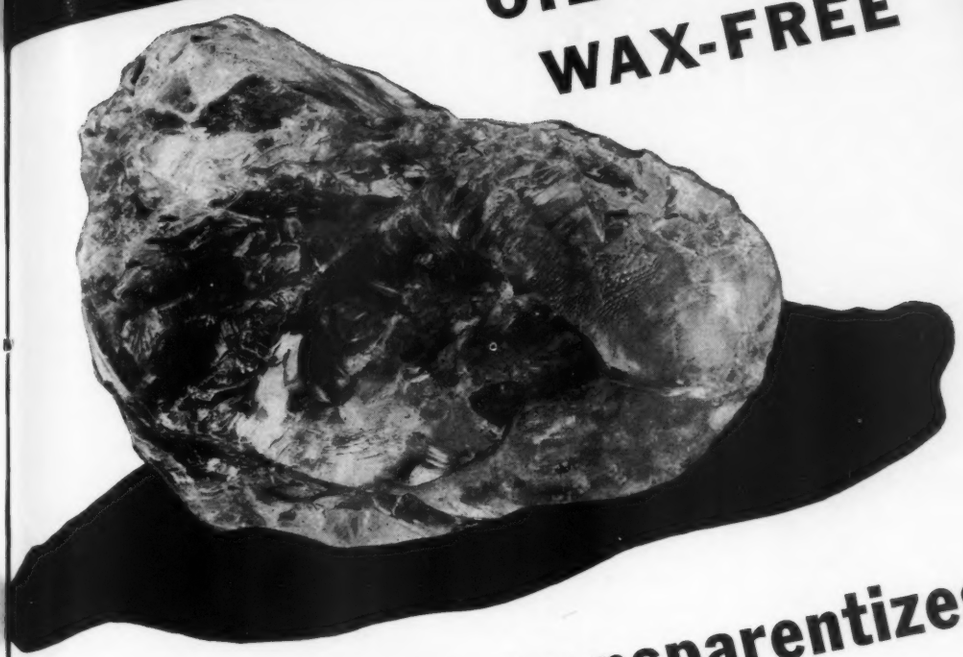

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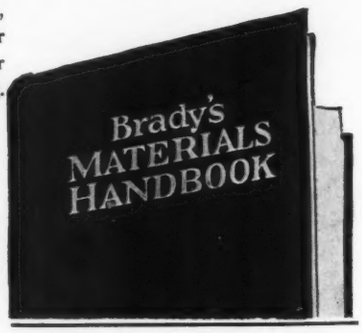

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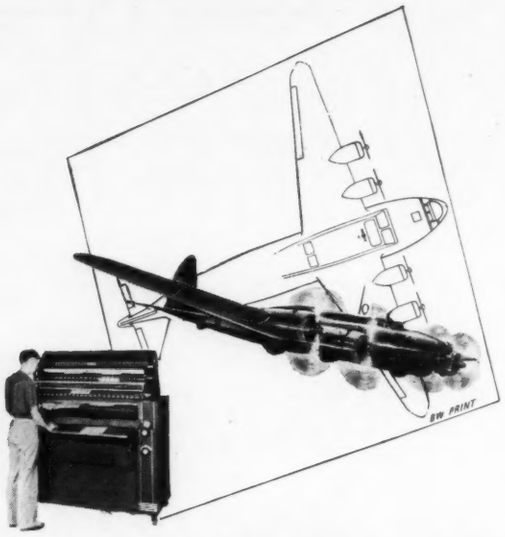

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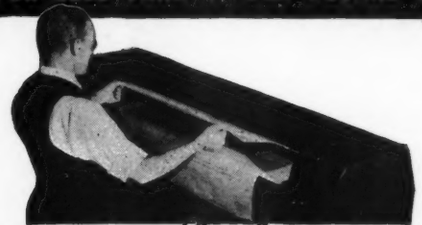

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Mr. Reader:

Can You Shout Loud Enough To Be Heard From Maine To California?

Sure, it's a silly question—'cause everybody knows you can't—that is, without other aid. We used it merely to give point and emphasis to the fact that this page can carry a message for you not only that far, but farther. Through an advertisement on this page you can contact men from Maine to California, from Florida to Washington, and all points in between.

Your advertisement on this page will go before that special group of men who — like yourself — have a business interest in the creation, design and development of machinery and engineered metal products. There are over 10,800 subscribers who read Product Engineering for news of everything pertinent to their profession.

You can whisper or shout your message—in type—to these other readers. Small Want-type ads cost only a dime a word or you can "shout" your message in prominent type — in individual space — at the rates quoted in the heading.

It has been Product Engineering's privilege to serve hundreds of advertisers through its Searchlight Section. By far the greater part of these advertisers have been *readers* of Product Engineering who recognized that *other* readers were most likely to be interested in or to respond to their offerings or wants. If you have Employment, Equipment or Business Opportunities to offer for the attention of other readers of Product Engineering your advertisement on this page will come to their attention wherever they may be located.

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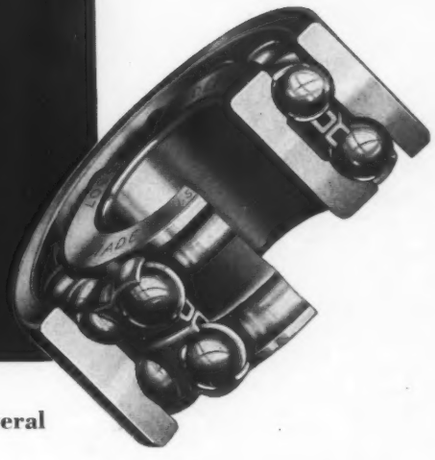
Like a ONE MAN BAND *. . . this multi-purpose bearing*



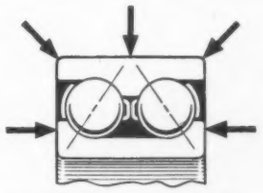
● **The New Departure Double Row bearing is an *expert* at doing several jobs *well*—at the same time.**

It resists radial and thrust loads in *any combination*, with thrust in either direction or reversing . . . provides extremely rigid support under pure radial loads.

It resists misalignment so positively, that in many cases it may be used alone, without need for a second or supporting bearing.

It is a compact, internally preloaded *unit*, applicable in numerous instances *without* need for shaft threads or locknuts.

Here is a truly versatile bearing. Use it to simplify your design. Let it help to save you money and build a better product. 2941



TWO JOBS—ONE BEARING

Big advantages in economy of manufacture and machine performance result from the use of the Angular Contact Double Row ball bearing *which was originated by New Departure* to resist both radial and thrust loads.

Today automobiles, trucks, tractors and machinery of many kinds depend upon bearings developed by New Departure from this original dual purpose "new departure."

NEW DEPARTURE

THE FORGED STEEL BEARING

NEW DEPARTURE - DIVISION OF GENERAL MOTORS - BRISTOL, CONNECTICUT - DETROIT - CHICAGO

December, 1940

Mg

TAKES OFF SIX POUNDS FROM PORTABLE SANDER

The Porter-Cable Machine Company of Syracuse, N. Y., have taken six pounds off the weight of their portable Take-About Sander by using magnesium (Mg) metal.

This machine, Type T-4, with inbuilt vacuum system and containing a 1¼ H.P. Universal motor, weighs only 27 pounds. The designers attained this sizable weight reduction by making the Sander's case of DOWMETAL* Magnesium Alloy.

Weighing a full third less than any other metal in common use, DOWMETAL is naturally a favored material for portable tools of all kinds. It makes them far easier to handle and, tough and durable, it stands up under severe usage.

DOWMETAL'S scope of applications is far reaching because these useful magnesium alloys are available in sand, die and permanent mold castings, forgings, sheet, strip, plate, bars, tubes, structural and special extruded shapes. Full technical information will be supplied on request.

The entire case of this Porter-Cable Take-About Sander is a DOWMETAL sand casting.

Be sure to see the Dow Exhibit at National Chemical Exposition, Chicago

DOWMETAL

MAGNESIUM ALLOYS

LIGHTEST OF ALL STRUCTURAL METALS

THE DOW CHEMICAL COMPANY, MIDLAND, MICH.

Branch Sales Offices: New York City, St. Louis, Chicago, San Francisco, Los Angeles, Seattle.

*Trade Mark Reg. U.S. Pat. Off.